Little Chute Locks and Dam
Between the 27.7 mile marker and the
25.6 mile marker on the Lower Fox River
Little Chute
Outagamie County
Wisconsin

HAER No. WI-88

HAER
WIS
44-LITCH,
2-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Rocky Mountain System Support Office
National Park Service
P.O. Box 25287
Denver, Colorado 80225-0287

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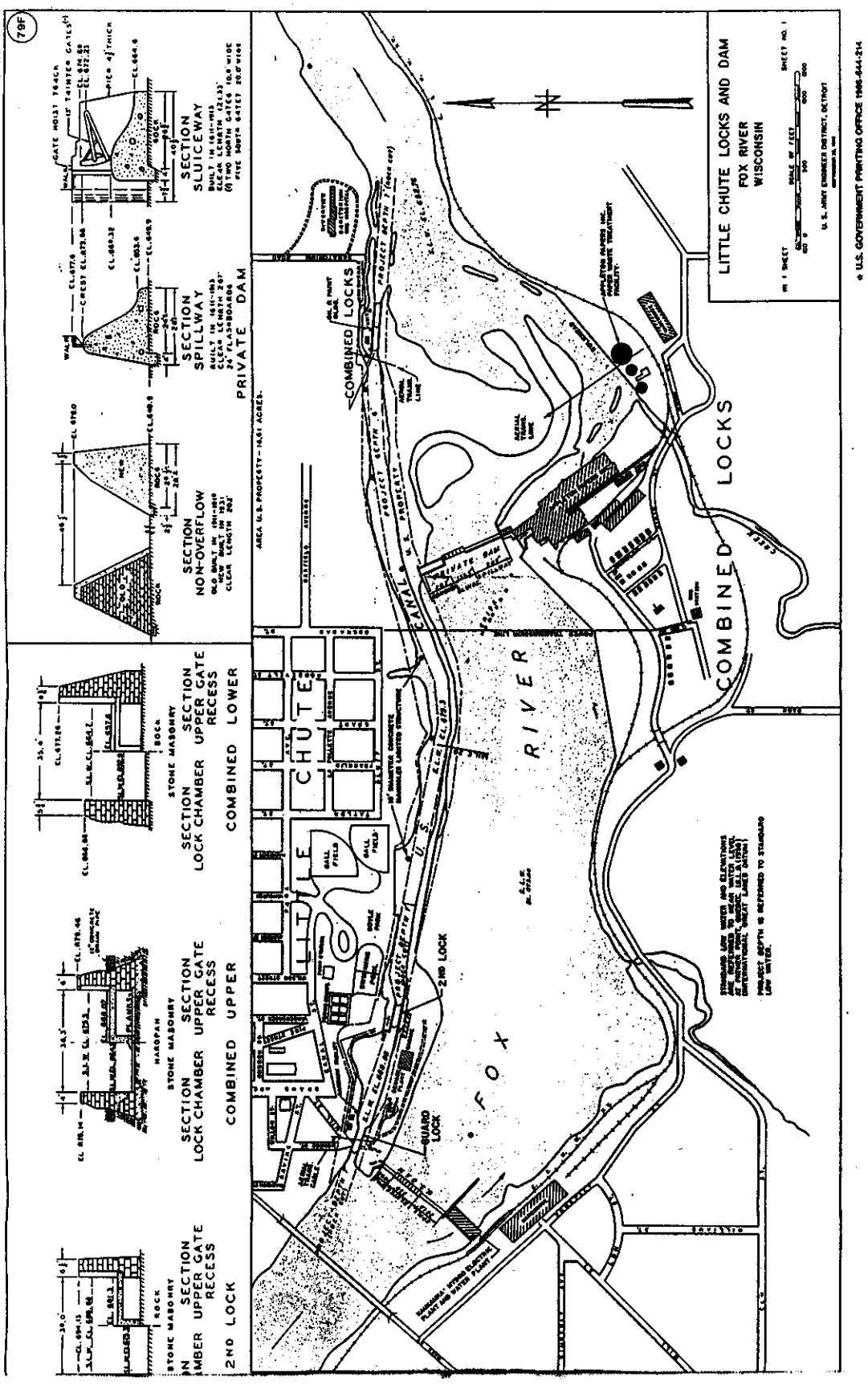
LITTLE CHUTE LOCKS AND DAM

HAER NO. WI-88

Location:	The Little Chute Locks and Dam Complex is located in the City of Little Chute extending from river mile 27.7 down river to river mile 25.6, Sections 21, 22 and 26, T21N, R18E, Civil Towns of Vandenbroek and Buchanan, Outagamie County, Wisconsin. UTM: North bank of dam 16/394850/4903140 South bank of dam 16/394720/4902980 Guard lock 16/394930/4903210 Lock 2 16/395180/4903130 Combined locks 16396670/4903120 USGS Quadrangle: Kaukauna, Wisconsin 7.5' series
Date of Construction:	1874-1941
Engineer:	United States Army Corps of Engineers with Contractors
Architect:	United States Army Corps of Engineers with Contractors
Present Owner:	United States Army Corps of Engineers
Present Use:	The locks at Little Chute are currently not in use. The Little Chute Dam remains operational.
Significance:	The Little Chute Locks and Dam Complex allowed passage for water craft in an otherwise unnavigable stretch of the Fox River at Little Chute created by a 36 foot drop in elevation in a little under 1 mile. The Little Chute Locks and Dam Complex served as an integral part of the Lower Fox River Waterway System.
Project Information:	This documentation was undertaken in 1995 in accordance with requirements detailed in a June 19, 1994 letter from Gregory D. Kendrick, Chief, History Branch, NPS to Dale Monteith, Acting Chief, Planning Division, USACOE, Detroit District. The Lower Fox system remains basically operational but was placed in caretaker status by the USACOE in 1982. The USACOE plans to divest itself of the Lower Fox system as soon as is feasible; therefore, NPS requested this documentation. All documentation conforms to HAER standards. Dr. John D. Richards, Principal Investigator; Georgia A. Lusk, Patricia B. Richards, and Robert J. Watson, Project Archivists with Great Lakes Archaeological Research Center, Inc.; Joseph Paskus, Project Photographer.


U. S. ARMY
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LITTLE CHUTE LOCKS AND DAM
FOX RIVER
WISCONSIN
SECTION SLUICEWAY
SECTION SPILLWAY
SECTION NON-OVERFLOW
PRIVATE DAM
COMBINED LOCKS
COMBINED UPPER LOCK
COMBINED LOWER LOCK
SECTION LOCK CHAMBER
SECTION UPPER GATE RECESS
2ND LOCK
GUARD LOCK
LITTLE CHUTE
FOX RIVER
CANAL
COMBINED LOCKS
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LITTLE CHUTE LOCKS AND DAM

General Description

The Little Chute Locks and Dam Complex is located in the City of Little Chute, Wisconsin. The complex provides passage around an otherwise unnavigable length of the Fox River characterized by a 36 foot drop in elevation in a little under 1 river mile. The Little Chute Locks and Dam Complex consists of a dam, a canal, a guard lock, a single upstream lock and two downstream locks which have been combined into one unit, two waste weirs, two lockkeeper's residences, two lock shelters, two garages, two storage buildings, and one sanitary building.

History

In 1848, The Board of Public Works of the State of Wisconsin appointed engineer Condy R. Alton to survey and assess the condition of the dams on the Fox River and suggest navigational improvements to other areas of the river.[1] Following the survey, Alton noted "formidable rapids" at Little Chute and proposed construction of a 500 foot long, 6 foot high dam, an 8,316 foot long canal, and four locks. Alton estimated improvement costs at $70,929.[2]

Despite an ongoing funding debate, the Board of Public Works contracted with Morgan Martin to construct the facilities at Little Chute in 1852.[3] According to the contract, the locks were to be built of stone and timber and would measure 160 feet in length, 5 feet in depth and 35 feet in width. Construction of the facilities at Little Chute was completed in 1856.[4]

In 1866, Major Charles Sutter was appointed to survey the entire system and make recommendations for maintenance and improvement. At Little Chute, Sutter noted that all four locks were in need of maintenance and that Lock 2 needed two new gates.[5] Although the facilities owners, the Green Bay and Mississippi Canal Company, acted on some of Sutter's recommendations regarding other complexes in the Fox River system, no improvement work was undertaken at the Little Chute Lock and Dam.

Following the purchase of the Fox River lock and dam system by the federal government in 1872, another assessment survey was conducted by government surveyors. During the course of that survey, it was determined that the combined locks at Little Chute were in poor condition and should be completely replaced. It was also noted that the Little Chute dam could not hold another foot of head. Consequently, if additional head was required, a new stone dam should be built.[6]

Subsequent to the 1872 survey, the United States Army Corps of Engineers embarked on a program designed to improve navigation on the Fox-Wisconsin Waterway.[7] The plan called for all the facilities on the Lower Fox to be repaired, followed by rebuilding of locks and dams on the Upper Fox. In addition all canals were to be dredged as needed. By 1880 the combined (downstream) locks at Little Chute had been rebuilt using quarried stone.[8] Between 1880 and 1890 Little Chute Lock 1 (now the guard lock) was also rebuilt.[9] Finally, in 1933, the stone dam at Little Chute was replaced with a concrete facility. Since the completion of the concrete dam, there have been no major alterations to the Little Chute complex.

LITTLE CHUTE DAM

The existing dam at Little Chute has not changed structurally since 1933. The dam is oriented NNE/SSW and extends for an overall length of 561 feet, 8 inches. The dam is comprised of three sections: a northern spillway, a central sluiceway containing nine concrete sluices, and a southern

spillway.[10] The spillways maintain a maximum pool elevation of 690.58 feet above sea level.[11] The dam is attached to the bedrock of the riverbed with split anchor bolts.

North Spillway

The north spillway, located nearest the Little Chute guard lock, measures 109 feet 10 inches in length. The length of the North spillway is defined by the portion of the dam between the channel face of the northernmost pier section of the sluiceway and the northeast (left) dam abutment.[12]

The northern end of the north spillway is connected to a concrete dam abutment. The abutment is 45 feet 1 inches in length and rises to a height of 17 feet 6 inches. The side of the abutment that faces the river is vertical while the landward face is tapered from 7 feet 3 inches at the base to 3 feet 9 inches at the abutment's top.[13] The northernmost edge of the dam is attached to the abutment by twenty 1 inch x 2 foot 6 inch machine bolts with double cinch anchors set 1 foot into the abutment. The southern end of the north spillway is anchored to the sluiceway by ten 1 inch by 3 foot machine bolts screwed into sleeve nuts.

The north spillway is comprised of 8 poured concrete construction sections anchored to the river's rock bottom by grouted steel anchor bolts. The construction sections vary in width according to their position in the spillway. The four northernmost construction sections are 14 feet 4 1/4 inches wide. The four southernmost construction sections are narrower at 13 feet 1 1/4 inches. All eight construction sections are 24 feet 6 inches in length.[14]

Aside from differing widths, each construction section on the north spillway conforms to specifications of a generalized construction plan. The upstream face of the north spillway, is tapered at a 12V:5H slope from the upstream base to a point located at an upstream horizontal distance of 2 feet from the crest line. From this point, the upstream face of the spillway is curved at a 2 foot 2 inch radius to the crest line. The downstream face is constructed as a compound curve consisting of three tangential circles with radii of 9 feet, 7 feet 6 inches, 4 feet.[15]

Each construction section in the north spillway extends 12 feet 6 inches above the bedrock surface of the river bottom to reach a crest elevation of 690.58 feet above sea level. The downstream toe of the spillway rises 1 foot 6 inches above the average elevation of the river bottom in order to reach maintaining an average elevation of 679.58 feet aabove sea level.[16]

The fifth construction section from the abutment end of the north spillway supports the spillway's only concrete pier. This pier serves as a base for a metal walkway running the length of the spillway.[17] The longitudinal centerline of the walk pier is located 2 feet 6 inches from the southern edge of the fifth construction.

The walkway pier on the fourth construction section of the northern spillway is bullet shaped, with the parabolic end pointing upstream. The pier measures 8 feet 4 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the pier maintains its maximum width of 3 feet for a length of 4 feet 10 inches at which point the sides begin to curve gently towards the tip of the parabola.[18]

In profile, the walk pier is somewhat rectangular, with a concave bottom conforming to the curved surfaces of the spillway construction section. On the downstream end of the pier two 12 inch risers carry the elevation from 695.80 fto 693.80 feet above sea level.[19]

A walkway spans the entire length of the north spillway from the dam abutment to the first pier of the sluiceway. The walkway over the north spillway consists of channel iron bolted onto the walk

pier sections with split anchor bolts fitted with specially beveled washers.[20] The interior space between the channel beams is spanned by I beams which have been bolted to the channel iron using L braces. The horizontal I beam sections serve as support ribs for the walkway decking.

South Spillway

The south spillway, located adjacent to the Combined Locks Paper Company pulp mill, measures 221 feet 10 inches in length. The length of the South Spillway is defined by the portion of the dam between the channel face of the southernmost pier section and the sluiceway.[21]

The southern end of the south spillway is connected to an existing wing dam owned by the Combined Locks Paper Company pulp mill. The south spillway is comprised of 16 poured concrete construction sections anchored to the river's rock bottom by grouted steel anchor bolts. The construction sections vary in width according to their position in the spillway. The southernmost construction section abutting the wing dam is 13 feet 6 1/4 inches wide. The adjacent three sections are each 14 feet 4 1/4 inches wide. The next eight sections are each 14 feet 1 1/4 inches in width. The remaining four construction sections are each 13 feet 1 1/4 wide. All 16 construction sections are 24 feet 6 inches long.[22]

Apart from their differing widths, each construction section on the south spillway conforms to specifications of a generalized construction plan. The upstream face of the south spillway is tapered at a 12V:5H slope from the upstream base to a point located at an upstream horizontal distance of 2 feet from the crest line. From this point the downstream face of the south spillway is constructed as a compound curve consisting of three tangential circles with radii of 9 feet, 7 feet 6 inches, 4 feet.[23]

Each construction section in the south spillway extends 12 feet 6 inches above the bedrock surface of the river bottom to reach a crest elevation of 690.58 feet above sea level. The downstream toe of the spillway rises 1 foot 6 inches above the river's bottom to maintain an average elevation of 679.58 feet above sea level.[24]

Beginning at the wing dam, every fourth construction section of the south spillway supports a concrete pier which serves as a base for a metal walkway which extends the length of the spillway.[25] The longitudinal centerline of each walkway pier is located 2 feet 6 inches from the southern edge of the construction section on which it is located.

The walk piers of the southern spillway are bullet shaped with the parabolic end pointing upstream. Each pier extends 8 feet 4 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the piers maintain their maximum width of 3 feet for a length of 4 feet 10 inches, at which point the sides begin to curve gently towards the tip of the parabola.[26]

In profile, the walk piers are somewhat rectangular, with concave bottoms conforming to the curved surfaces of the spillway construction sections. The piers were designed to maintain a maximum elevation of 695.80 feet above sea level. On the downstream ends of the piers two 12 inch risers carry the elevation from 695.80 to 693.80 feet above sea level.[27]

A walkway spans the entire length of the south spillway from the dam abutment to the first pier of the sluiceway. The walkway over the south spillway consists of channel iron bolted onto the walk pier sections with split anchor bolts fitted with specially beveled washers.[28] The interior space between the channel beams is spanned by I beams which have been bolted to the channel iron using L braces. The horizontal I beam sections serve as support ribs along the entire length of the walkway.

Sluiceway

The sluiceway of the Little Chute dam is centrally located in the overall dam layout and is flanked by the two spillways.[29] The overall length of the sluiceway is 230 feet.[30] The sluiceway is comprised of 10 poured concrete construction sections. Each sluiceway construction section is anchored to the bedrock of the river bottom by 4 rows of anchor bolts spanning the width of the section. The first row of bolts is located 6 feet from the upstream edge of the section. The second row of bolts is located 6 feet from the first row, with subsequent rows spaced at 6 foot 9 inch intervals. The first row of bolts consists of six 1 1/2 inch by 4 foot 6 inch split bolts grouted 18 inches into the bedrock; the second row consists of six 1 inch by 4 foot split bolts also grouted 18 inches into the bedrock. The third row of bolts includes six 1 inch by 3 foot 6 inch split bolts grouted 18 inches into the bedrock. The last or fourth row of bolts consists of six 1 inch by 3 foot split bolts also anchored 18 inches into the bedrock. The spillway construction sections are additionally secured by a 4 foot wide concrete key poured into a trench cut at a minimum depth of 2 feet into the bedrock. The concrete key and keyway extends the entire length of the sluiceway.[31]

The construction sections of the sluiceway conform to the specifications of a generalized construction section plan. With the exception of the sections at the extreme ends of the sluiceway, which are 15 feet in width, each of the construction sections is 25 feet wide. Measured parallel to the river's channel, each section has a basal length of 28 feet.[32]

Somewhat ramp-shaped in profile, the sluiceway construction sections reach a maximum height of 4.4 feet above the average elevation of the river bottom, or 682 feet above mean sea level. From an upstream height of 2.9 feet above the average elevation of the river bottom, the sluiceway sections slope up toward the downstream end. The 4.4 foot maximum thickness is maintained for a horizontal distance of 8 feet, at which point the section begins to slope gently downstream to a height of 1 foot 6 inches above the average elevation of the river bottom, or 679.0 feet above sea level.[33]

The sluiceway construction sections are secured together by lengths of 1 inch diameter rebar which extend the width of the section and are spaced at 15 inch intervals. Additional lengths of 3/8 inch diameter rebar are spaced at 2 foot intervals. The seams between sluiceway construction sections are filled by construction joints.[34]

The sluiceway construction sections of the Little Chute dam serve as foundations for a series of 10 upright piers which not only support a sluiceway walkway, but also contain the gate pins on which the sluiceway taintor gates are hung. Eight of the sluiceway piers are located along the centerlines of sluiceway construction sections, while the two end piers are located at the ends of the northern and southern sections closer to the spillways.[35] Nine sluiceway openings are created by the placement of the pier sections.

The sluiceway piers are 28 feet in length, and are 5 feet wide. The upstream ends of the piers are parabolic in shape and are curved along a radius of 6 feet 3 inches. The upstream nose of each of the piers is armored with an 18 foot 2 inch long section of 4 by 4 by 3/8 inch angle iron secured to the pier with 3/4 inch by 18 inch steel bolts. Sluiceway pier heads measure 4 feet 4 inches from the parabolic tip of the upstream end to the downstream edge. Immediately posterior of the pier heads is a "stop log" slot which extends the entire height of the pier section. The stop log slots, which are 6 inches deep and 13 inches wide, are located on pier faces interior of sluiceway openings. The downstream corners of the stop log slots have been armored with 16 foot 8 inch long sections of 4 by 4 by 3/8 inch angle iron secured to the pier face with 3/4 inch by 18 inch steel bolts.[36]

The sluiceway piers are tied to the sluiceway construction sections by two rectangular concrete keys, sections of rebar, and anchor bolts. Both concrete keys extend 6 inches from the top of the sluiceway sections into the bottom of the pier sections. The first key, located on top of the horizontal section of the sluiceway construction section, is 6 feet long and 2 feet wide. It is secured to the sluiceway construction section with two rows of 3 foot 6 inch long, 3/4 inch diameter bars. The second key, located on top of the slanted downstream end of the sluiceway construction section is 10 feet long and 2 feet wide. It too is secured to the sluiceway construction section with two rows of 3 foot 6 inch long, 3/4 inch diameter bars. In addition to the concrete keys, each sluiceway pier is tied to the construction sections with 18 sections of 3/8 inch diameter rebar. The rebar sections are spaced 20 inches center to center. The lengths of the rebar sections vary from 17 feet 6 inches to 13 feet 6 inches according to their position in the pier section.[37]

In profile, the sluiceway piers are rectangular, with concave bottoms conforming to the curved surfaces of the sluiceway construction sections. The tops of the upstream portion of the piers reach an elevation of 698.67 feet above sea level, while the downstream portions maintain a surface elevation of 693.33 feet above sea level. Eleven feet nine inches from the nose of the piers, the top of each construction section is stepped by four 16 inch risers that connect the upstream and downstream pier surfaces.[38]

Fourteen foot high steel taintor gates are located within each of the sluiceway openings. Detailed design plans specific to the gates of the Little Chute dam are not available. However, the design of the Little Chute gates is similar to that of other dams in the Fox River system. Thus, available plans from these facilities were used to supplement visual inspection of the Little Chute sluiceway gates. The taintor gates are hung on a cold rolled steel gate pin by a cast steel gate hinge.[39] Each gate is connected to the gate hinges by end girders and bracing composed of angle iron. The upper and lower arms of the end girders are sections of angle iron fastened to the gate hinges with rivets. The upper and lower arms of the taintor gate end girders form the sides of an isosceles triangle with the apex located at the gate hinge. The arms of the end girders are braced with three sections of triangulated angle iron. Two of these angle iron sections are also connected to a steel web plate which spans the space between the upper and lower arms directly behind the taintor gate face. The space between gate end girders is spanned by sections of channel iron running the width of the gate and connecting the upper and lower arms of opposite gate end girders. Additional bracing between end girders is located behind the gate face at the top and bottom of the gate. A steel web plate is located directly behind the gate face at the centerline of the gate. This web plate is tied to the horizontal gate bracing by two sections of angle iron.[40]

The fronts of the sluiceway gates are faced with steel plates secured to the gate bracing and web plates by horizontal I beams. Seams between the plates are secured by strips of steel plate that extend the entire height of the taintor gate. An oak beam is bolted to the channel iron running along the foot of the gate, providing a sill for the gate.[41]

The sluiceway gates of the Little Chute dam are operated by a "crab," a mechanism containing a pair of electric winches that moves from gate to gate along a track on top of the sluiceway.[42] The crab is constructed of two 21 foot lengths of channel iron connected parallel to each other by four sections of 2 foot 2 1/2 inch by 12 foot long I beam. The crab winches are powered by a five horsepower open type wound rotor electric motor mounted at the middle of the crab frame. A winch hand wheel is also located near the middle of the crab frame. The crab mechanism rides along a 3 foot 8 inch guage track mounted along the downstream length of the sluiceway.[43]

In order to raise or lower a gate, the crab is positioned over the gate, and the winch chains are connected to the hoist chain connections on the gate. Once positioned, the crab is connected to a power source, and the winches are turned on until the gate has been raised to the desired height.

Once this height is reached, the crab is disconnected from the power source and moved to the next gate to be opened.[44] The electric winches are capable of lifting the gate at a rate of 2 feet per minute. In contrast, 61.5 revolutions of the hand wheel are required to lift the gate 1 foot.[45]

When not in use, the crab mechanism is housed in a wooden gate hoist house built over the span between the two northernmost sluiceway piers.[46] The gate hoist house is built on top of two 22 foot 4 inch long horizontal timbers spanning the space between the sluiceway piers. Along the upstream side of the gate hoist house, a 4 inch by 4 inch sill plate has been bolted directly to the top of the sluiceway walkway planking. The sill plate on the downstream side of the gate hoist house is a 4 inch by 8 inch beam which has been bolted 1 foot 3 inches above the top of the sluiceway pier section. At each end of the sill plates, 4 inch by 4 inch wall studs are fastened directly to the sill plate. Between these beams, 2 inch by 4 inch studs have been spaced 2 feet apart, center to center.[47] On top of the 4 inch by 4 inch wall studs, two 2 inch by 4 inch beams have been strung to form the top plate.

A 2 foot 8 inch personnel door is located on the spillway end of the gate hoist house. A set of double doors on the sluiceway side of the gate hoist house allow the crab to be moved along its track and positioned at the gates. The upstream and downstream sides of the gate hoist house each contain a single window located in the center of the wall. The gate hoist house is covered with a moderately pitched, front-gabled asphalt shingle roof.[48]

A walkway spans the entire length of the sluiceway. The walkway consists of sections of channel iron bolted onto the sluiceway pier sections with split anchor bolts fitted with specially beveled washers.[49] The interior space between the channel beams is spanned by lengths of I beams which have been bolted to the channel iron. The horizontal I beam sections serve as support ribs spaced along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron have been spaced the length of the sluiceway to form the uprights for a handrail. The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. On each side of the west spillway walkway, lengths of galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[50]

The decking of the sluiceway walkway is made up of 25 foot long sections of 3 inch by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed onto 2 foot 4 inch sections of 4 inch by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams.[51]

LITTLE CHUTE CANAL

The Little Chute canal was excavated sometime after 1848, when Wisconsin Board of Public Works engineer Condy R. Alton proposed the construction of an 8,316 foot canal and four locks.[52] Work was in progress from 1853 through 1855.[53] The canal was finally completed in 1856. Waste water weirs have been excavated adjacent to Lock 2 and the downstream combined locks. The weirs are designed to carry overflow water past the locks and prevent damage to lock gates.[54]

The Little Chute lock canal as eventually constructed is approximately 5,450 feet in length, including the portion of the canal that lies within the lock. Generally oriented east/west, the canals depth averages 7 feet. The Combined Locks and associated waste weir are located at the

downstream end of the canal while Lock 2, an additional waste weir, and the guard lock are located at the upstream end of the canal. The canal's width varies between 40 and 200 feet.[55]

In most places, the banks of the Little Chute canal have been riprapped with stone. However, sections of the canal retain portions of the original dry stone wall construction that originally lined the entire canal. The Little Chute canal has been dredged periodically during its existence. Today, the northern bank of the canal is located adjacent to the city of Little Chute and Doyle Park. The southern bank of the canal lies along a small peninsula of made land.

GUARD LOCK

Information regarding the guard lock at Little Chute is derived from the National Register of Historic Places registration form for the Little Chute Locks and Canal Historic District. The guard lock is located at mile marker 27.7, on the northern side of the Fox River at the entrance to the Little Chute canal in the City of Little Chute. Guard locks are designed to protect the canal from a sudden surge of water and also facilitate drainage of the lock canals. Lock 1 was specifically modified to serve as a guard lock in 1885. Presently, the lock consists of two wooden mitre gates that are constructed of squared wooden timbers laid horizontally atop one another and joined with structural ties. The clear width of the guard lock is 355 feet 5 inches. The lock's cut stone masonry walls taper to a top thickness of 6.5 feet. The guard lock gates are operated with the same crank and spar system utilized throughout the Lower Fox River Dams system. The gate operating mechanism is described below. Downstream from the guard lock gates, a dry rubble wall, a portion of which is sheathed with planks, extends for 200 feet.[56]

LOCK 2

Oriented WNW/ESE Lock 2 at Little Chute was constructed in 1880.[57] The lock consists of a 144.2 foot (144 foot 2 1/2 inch) by 35 foot quarried limestone lock chamber with wing walls at each of its ends.[58] In design and operation Little Chute Lock 2 is essentially identical to Appleton Lock 3.[59]

The lower wing walls, located at the downstream end of the lock, consist of a single construction section comprised of quarried limestone blocks. The north (left) wall measures 16 feet 8 inches in length, while the south (right) wall measures 19 feet 6 inches in length. Both of the lower wing walls are 26.3 feet (26 feet 3 inches) high.[60]

The upper wing walls, located at the upstream end of the lock, also consist of a single construction section comprised of quarried limestone blocks. The north (left) wall measures 84 feet 8 inches in length, while the south (right) wall measures 33 feet in length. Both of the upper wing walls are 16.543 feet (16 feet 6 1/2 inches) high.[61]

Little Chute Lock 2 consists of an upper or upstream gate section, the lock chamber proper, and a lower or downstream gate section. The upper gate section is 42 feet long and the lock chamber is 88.95 feet (88 feet 11 1/2 inches) in length. The lower gate section extends an additional 39 feet 3 inches. Including the upper and lower gate sections, the overall length of the lock is 170.2 feet (170 feet 2 1/2 inches).[62]

The upper gate section is that part of the lock that houses the upper valve mechanisms used to fill the lock. Spaced 40 feet apart, the walls of the upper gate section are 26 feet 3 inches high. The lockward face of the walls are constructed of 19 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. The south wall of the upper gate section is 12 feet wide at the

base and is tapered to 4 feet 6 inches at top. The north wall is less massive, rising from a 7 foot wide base and tapering to a 4 foot 6 inch wide top.[63] The walls of the upper gate section are built directly on top of limestone bedrock with interior faces perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the gates to recess flush when opened.[64]

The upper gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams. In addition to the oak beams, the pine timbers used in the gate construction of the lock are secured together by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts. The upper lock gates are 12 feet high without valves, and span a width of 20 feet 7 inches.[65]

Six butterfly valves are utilized to allow the water level of the lock chamber to be raised. Three valves are grouped on either side of the upper gate section floor immediately outside of the lock gates. When the lock is to be flooded, the lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A horizontal bar is inserted into a socketed hub attached to a vertical shaft and serves as a handle with which to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the gate is closed and sealed, the butterfly valves are opened and water is allowed to flow through a culvert below the mitre sill and into the lock.[66] When opened, the six upstream valves fill the lock chamber to provide 13.6 feet of lift and match the 688.8 feet above sea level elevation of the upper pool in a little over 6 minutes.[67]

The lower gate section is that part of the lock which contains the lower valve mechanisms used to empty the lock. Spaced 35 feet apart, the walls of the lower gate section are 26 feet 3" high and 24 feet long.[68] The wall surfaces facing the lock channel consist of tiers of 17 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the south wall is 12 feet wide and tapers to 4 feet 6 inches at its top while the north wall is 7 feet at its base and is also tapered to 4 feet 6 inches at top. The walls of the lower gate section are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior faces of the upper gate walls are recessed 2 feet in order to allow the gates to recess flush when fully opened.[69]

The lower gates are constructed from timbers held together with 1/2 inch thick by 4 inch wide iron straps.[70] In addition to the exterior iron straps, the horizontal pine timbers are secured together by two 1/2 inch diameter rods which have been threaded through the interior of the gate along its entire height and bolted at both ends. The lower gates of Little Chute Lock 2 are similar to the upper gates in their construction, except that they are taller, rising to a height of 21 feet and spanning a width of 20 feet 7 inches.[71]

The lower lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the six butterfly valves located in the lower lock gates are opened and water is allowed to flow out of the lock. Located three to a gate, the valves are operated by levers located on the top of each gate. When opened, the lower valves can discharge the lock chamber to the lower pool elevation in 3 minutes and 58 seconds.[72]

The lock chamber walls between the upper and lower gate sections are constructed of tiers of quarried limestone blocks laid horizontally to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. The block walls of the north lock are 7 feet in width at the base, and are beveled to 4 feet 6 inches at the top. The south wall of the lock chamber has a wider 12 foot base, but is also beveled to 4 feet 6 inches at the top.[73] The walls of the lock chamber are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock.[74]

In recent years both sets of gates have been replaced or rebuilt. In addition, guard rails of galvanized pipe and concrete tripod platforms have been added to Lock 2.[75] However, apart from these improvements and other periodic maintenance Lock 2 at Little Chute appears very much as it did when construction was completed in the early 1880s.

Waste Weir

A waste water weir has been excavated adjacent to Lock 2. The weir was designed to carry overflow water past the locks and thereby prevent damage to the lock gates.[76] The waste weir at Lock 2 flows parallel to the north side of the lock. The weir canal has been constructed in the former lock chamber of an older, now abandoned lock that has been sealed on its upstream end. The walls of the weir canal consist of cut limestone blocks. The weir is approximately 200 feet long, and maintains an average width of 30 feet.

COMBINED LOCKS

The Combined Locks at Little Chute are oriented east/west and consist of two individual locks placed back to back, hence the designation "combined." The locks have changed little since their reconstruction during the years 1874 to 1877. Major alterations include replacement of the middle and lower lock gates, deepening of the lower lock chamber, and rebuilding the right wall of the upper lock on a new concrete footing.[77] The upstream end of the upstream lock consists of an upper gate section and upper wing walls. The downstream end of the downstream lock includes a lower gate section and a pair of lower wing walls.[78] Combined Locks is unique in the Lower Fox River system due to the presence of a third or middle set of gates situated equidistant from the upstream and downstream ends of the lock. The Combined Locks are similar in construction and design to Appleton Lock 3. Consequently, engineering details specific to Appleton Lock 3 were used to supplement information on design and construction of the Little Chute Combined Locks.[79]

Upper Lock

The upper lock consists of a 138 foot by 35 foot quarried limestone lock chamber with wing walls at the upstream end.[80] Both of the upper wing walls are constructed of quarried limestone block, and stand 9 feet high. The wing walls are beveled to a width of 3 feet at their tops. The northern wing wall is 42 feet in length, while the southern wing wall is 39 feet long.[81]

The lock chamber of the upper lock measures 170 feet between the quoins of the upper and lower gate sections.[82] The upper gate section is that part of the lock which contains the upper valve mechanisms used to fill the lock. Spaced 35 feet apart, the walls of the upper gate section are 20 feet 10 inches high and are 32 feet 6 inches long.[83] The walls of the upper gate section are built

directly on top of hardpan bedrock with their interior faces perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed 2 feet in order to allow the gates to recess flush when fully opened.[84]

The upper gate is constructed from pine timbers held together with 1/2 inch thick by 4 inch wide iron straps.[85] In addition to the exterior iron straps, the horizontal pine timbers are secured together by two 1/2 inch diameter rods which have been threaded through the interior of the gate along its entire height and bolted at both ends. The upper lock gates are 12 feet high without valves, and span a width of 20 feet 7 inches.[86]

The upper lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable steel bar is inserted in a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the four butterfly valves in the floor of the upper gate section are opened and water is allowed to flow through a culvert below the mitre sill and into the lock. The valves are operated by geared mechanisms connected to levers mounted on top of the lock gates. When opened, the four upstream valves can fill the lock chamber to provide the 10.6 feet of lift needed to match 675.3 feet above sea level elevation of the upper pool in a little under 4 minutes.[87]

Middle Gates

The following description is based on information gleaned from a blueprint titled "Sketch Showing Measurements and Elevations at Little Chute Combined Locks," which is dated December 16, 1925.[88]

The middle gate section is that part of the Combined Locks which contains the six butterfly valves used to empty the upper lock and fill the lower lock [89] The middle gate section is 29 feet long and varies in width in order to conform to the differing widths of the upper and lower locks. Its walls are constructed from cut stone blocks and achieve a height of 18 feet 10 inches. The walls of the middle gate section are built directly on top of the hardpan river bottom on their upstream ends and the bedrock of the river bottom on their downstream ends. Immediately upstream from the middle lock gates, the interior walls of the middle gate section are recessed 22 1/4 inches in order to allow the gates to recess flush when fully opened.[90]

The middle gates are constructed from pine timbers held together with 1/2 inch thick by 4 inch wide iron straps.[91] In addition to the exterior iron straps, the horizontal pine timbers are secured together by two 1/2 inch diameter rods which have been threaded through the interior of the gate running its entire height and bolted at both ends. The middle lock gates are 18 feet 10 inches high, and span a width of 20 feet 7 inches.[92]

The middle lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A horizontal bar is connected to the vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the middle gates are closed and sealed, the six butterfly valves in the floor of the middle gate section are opened and water is allowed to flow through a culvert below the mitre sill and into the lock. The valves are operated by geared mechanisms connected to levers mounted on top of the lock walls. When opened, the middle gate valves allow water contained in the upper lock to fill the lower lock.

Lower Lock

The lower lock consists of a 172 foot 6 inch by 35 foot 5 inch quarried limestone lock chamber with wing walls at its downstream end.[93] Both of the lower wing walls are 27 feet long, and constructed of quarried limestone blocks beveled to a width of 5 feet at their tops.[94] To compensate for the drastic change in elevation which occurs at the Combined Locks, there are 11 steps on each of the lower wing walls, which change the height of the walls from 21 feet 2 inches at the upstream end to 9 feet at the downstream end.[95]

The lock chamber of the lower lock at Combined Locks measures 146 feet 6 inches between the middle and lower gate sections.[96] Wall height of the lower lock is 31 feet at the upstream end and 21 feet 2 inches on the downstream end. This drastic change in height is facilitated by a series of 14 steps on the north and south walls of the lock chamber.[97] A 22 foot long lower gate section is located at the eastern end of the lock. The lower gate section is that part of the lock that contains the lower valve mechanisms used to drain the lock. Spaced 37 feet 3 inches apart, the walls of the lower gate section are 21 feet 2 inches high and 2 feet 10 inches wide at their tops. The walls of the lower gate section are built directly on top of the bedrock of the river bottom with their interior faces perpendicular to the natural rock floor of the lock. Directly upstream from the lower lock gates, the interior walls of the lower gate section are recessed 22 1/4 inches so that they can accommodate the gates when they are open.[98]

The lower gates at Combined Locks are constructed from square horizontal pine timbers held together with vertical oak beams.[99] In addition to the oak beams, the horizontal pine timbers are secured together by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts. The wooden lower lock gates are 20 feet 10 3/4 inches long.[100]

The lower lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A horizontal bar is connected to the vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, the six butterfly valves located in the lower lock gates are opened and water is allowed to flow out of the lock. Located three to a gate, the valves are operated by levers located on the top of each gate. When opened, the lower valves discharge the lock chamber to the lower pool elevation.[101]

Waste Weir

The waste weir at Combined Locks flows roughly parallel to the north side of the locks. Approximately 8 feet wide, the weir canal is constructed with a poured concrete and rubble bottom and side walls. At the head of the waste weir a small spillway carries overflow water into the weir canal. The spillway is bounded by concrete abutments topped by guard rails of galvanized pipe.

SIGNIFICANCE

The Little Chute Locks and Dam Complex is a part of the Lower Fox River Waterway constructed by private companies between 1850 and 1860 and rebuilt by the Army Corps of Engineers between 1872 and 1941. Conceived as part of the larger Fox River Waterway, the Lower Fox River System operated between Green Bay and Lake Winnebago. The locks and dam combination at the Little Chute Locks and Dam Complex allowed passage around rapids at Little Chute and served as an integral part of the Lower Fox River Waterway System.

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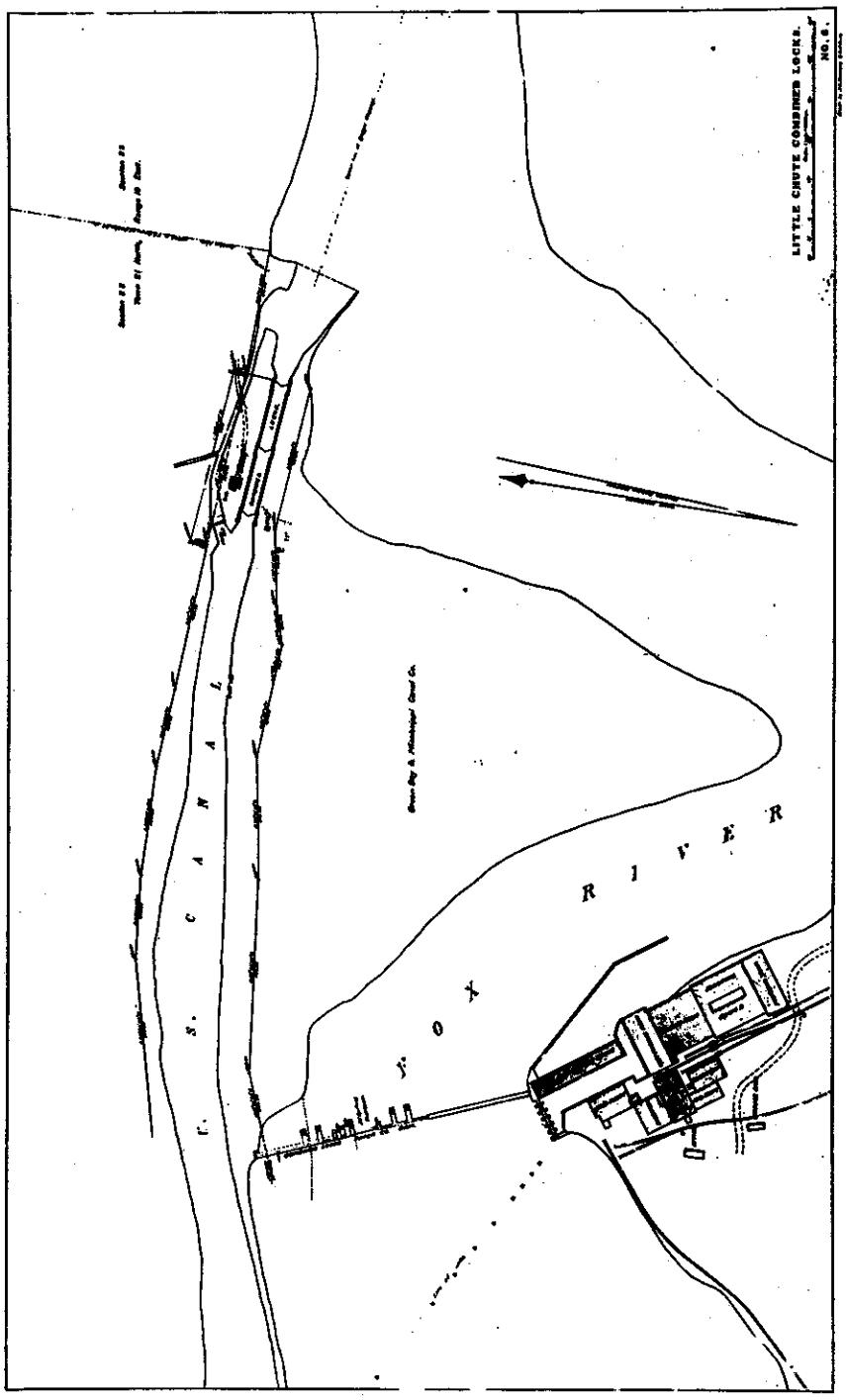

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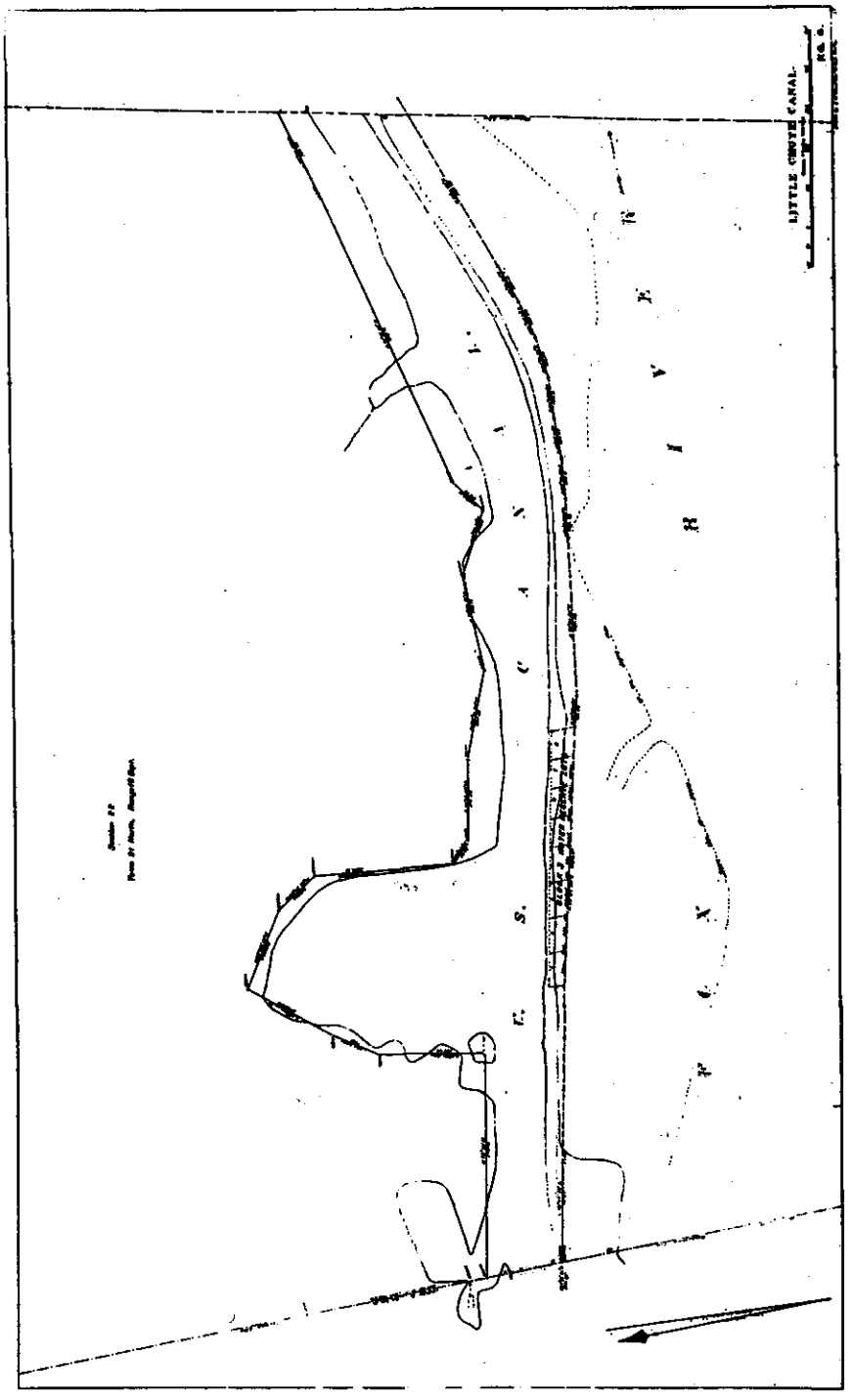

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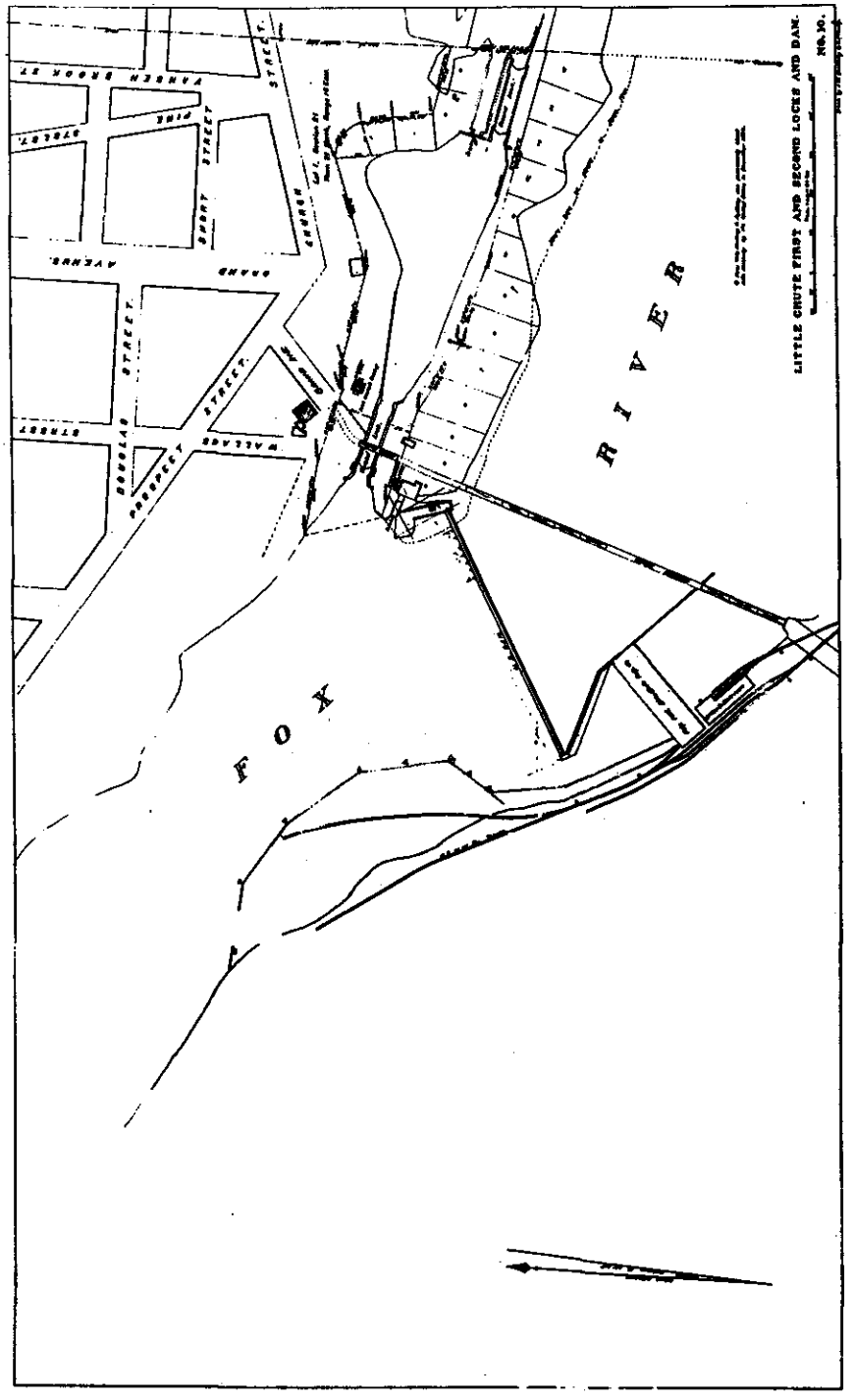

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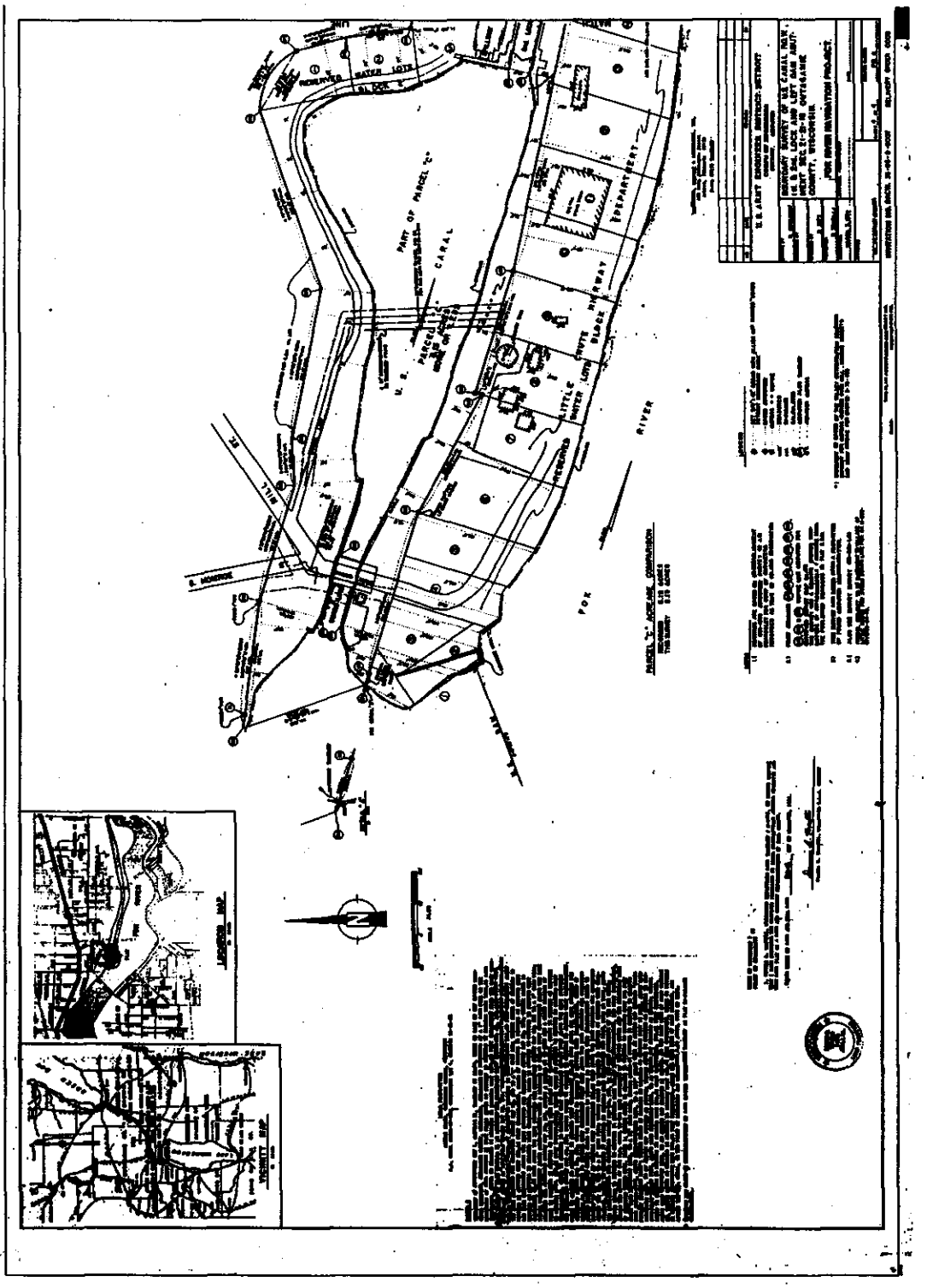

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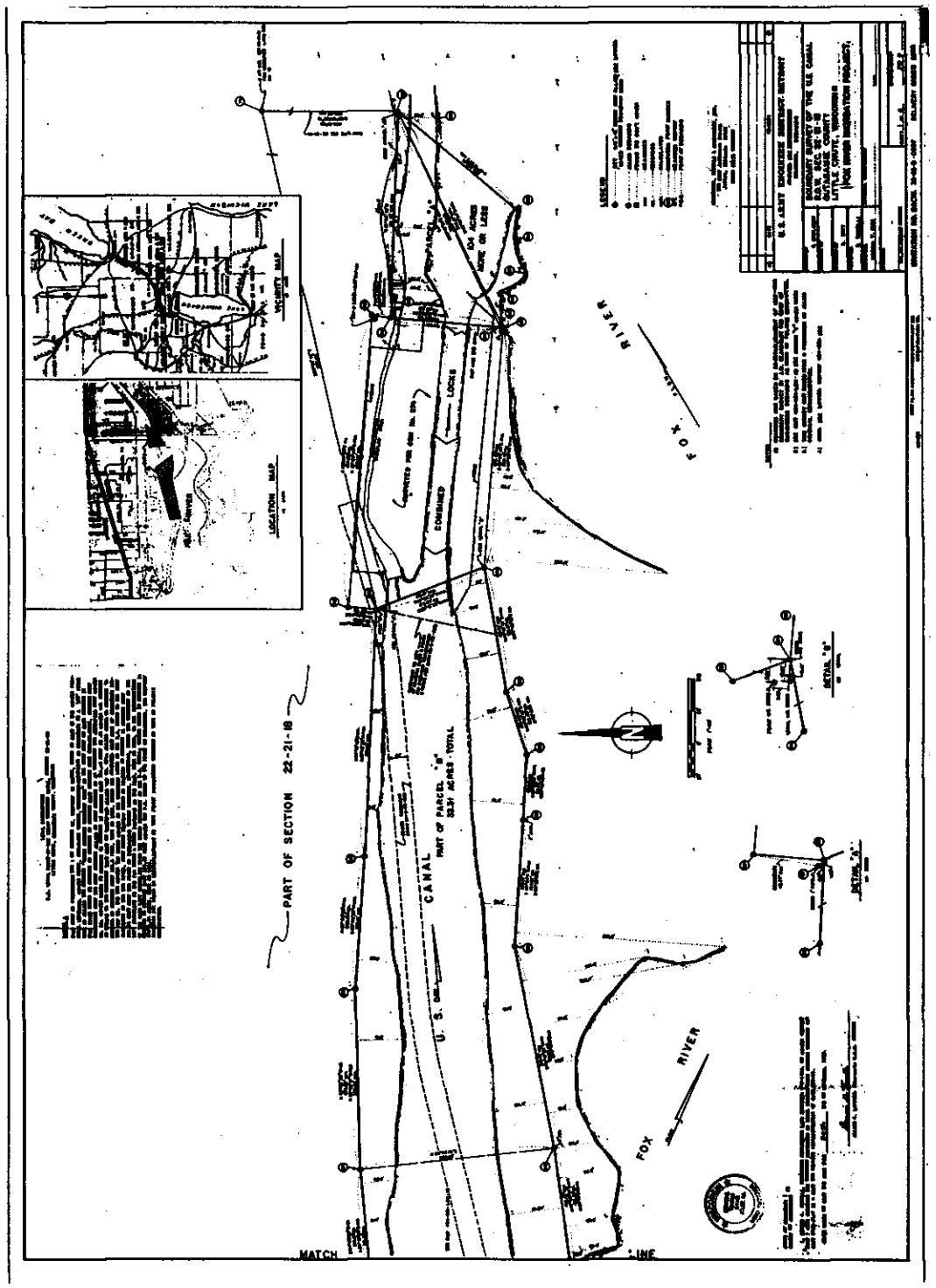

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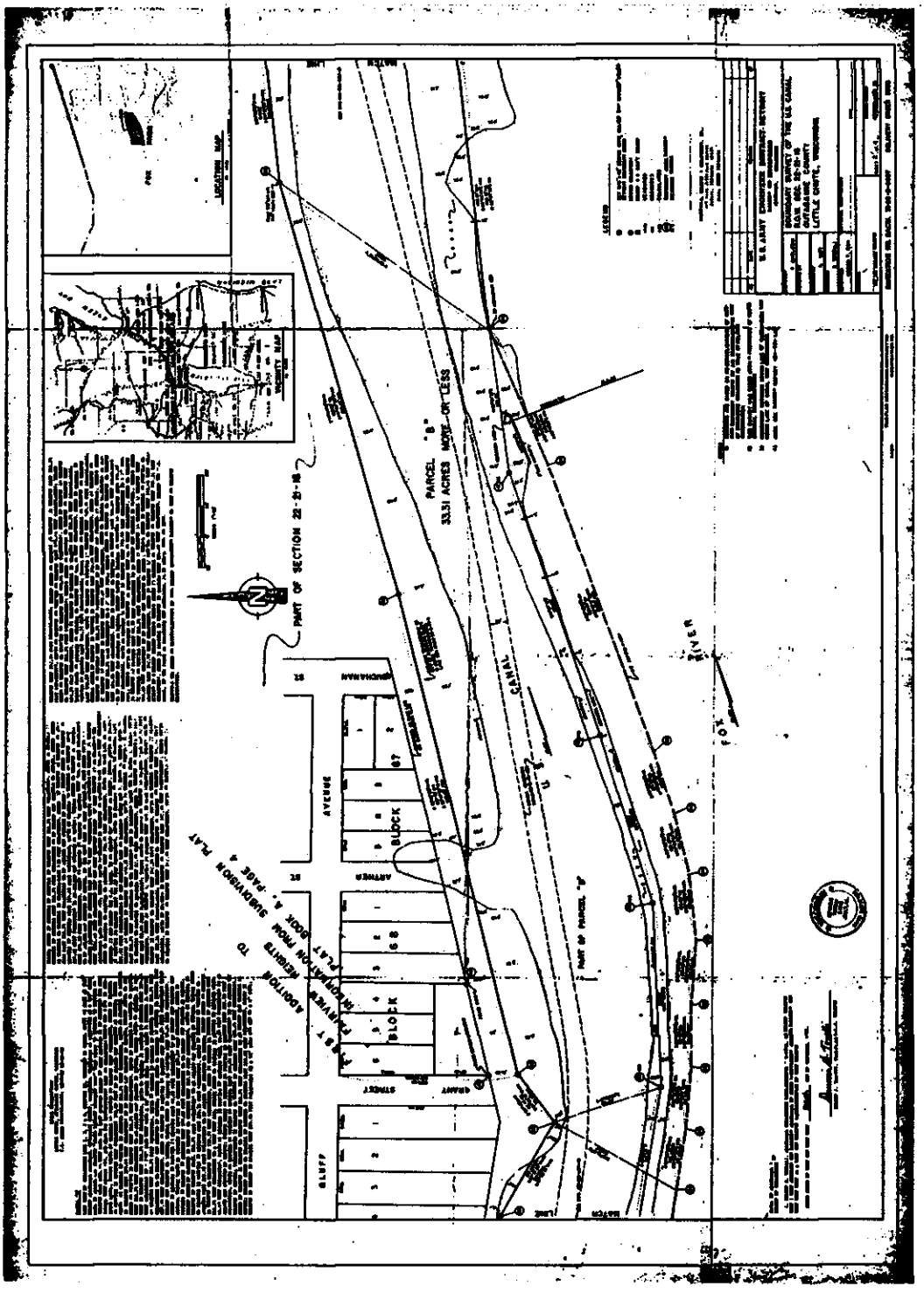

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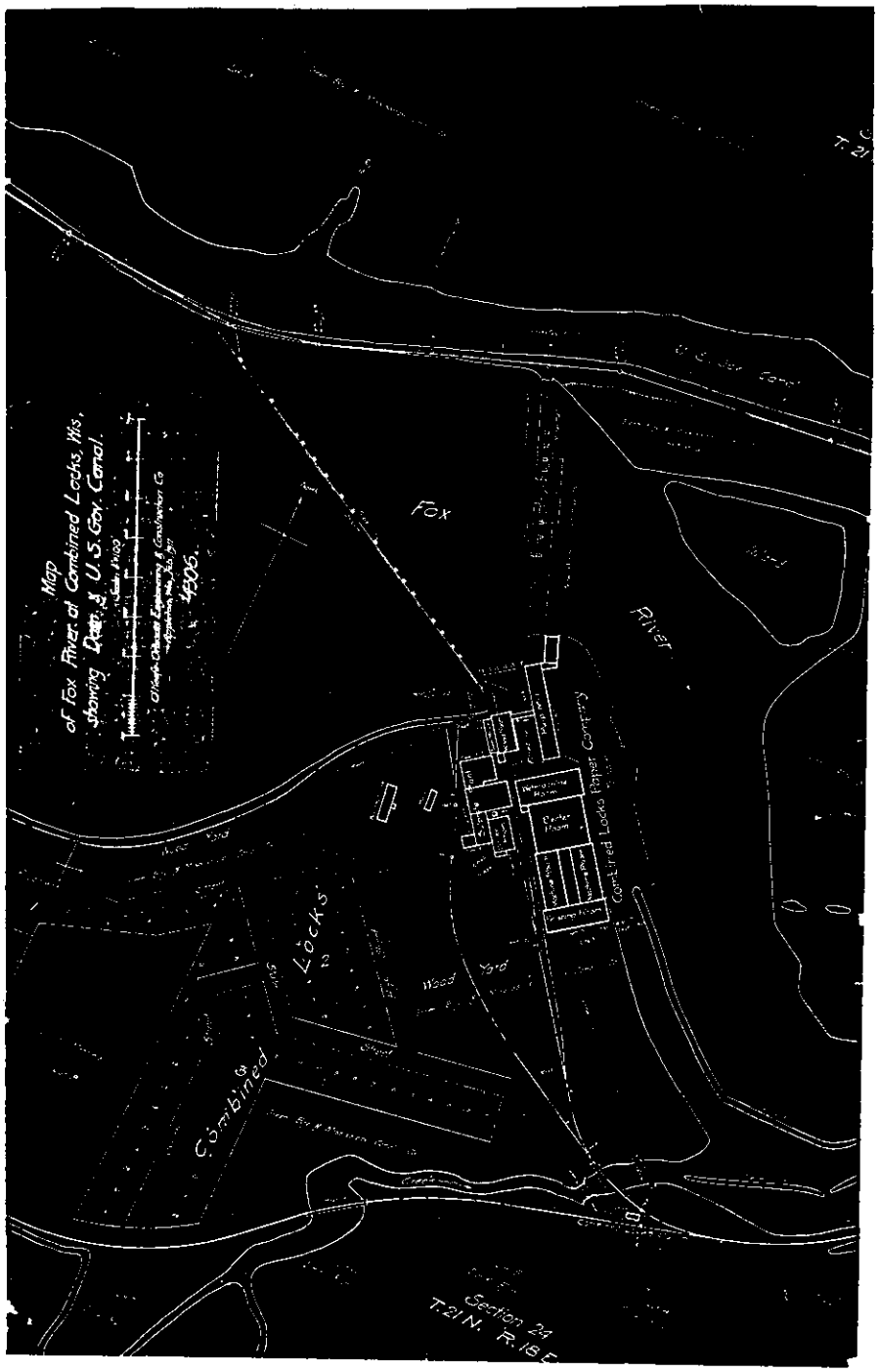

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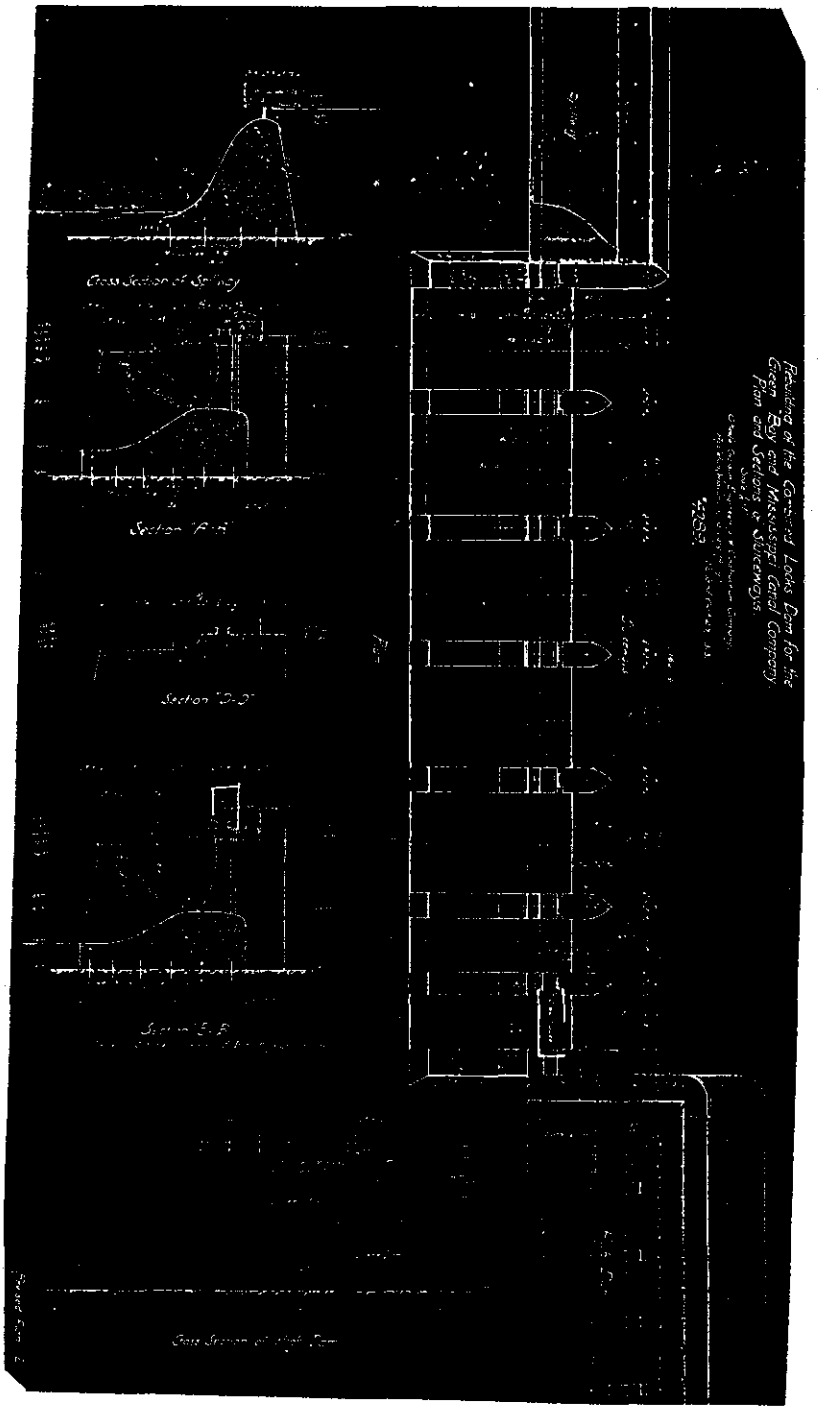

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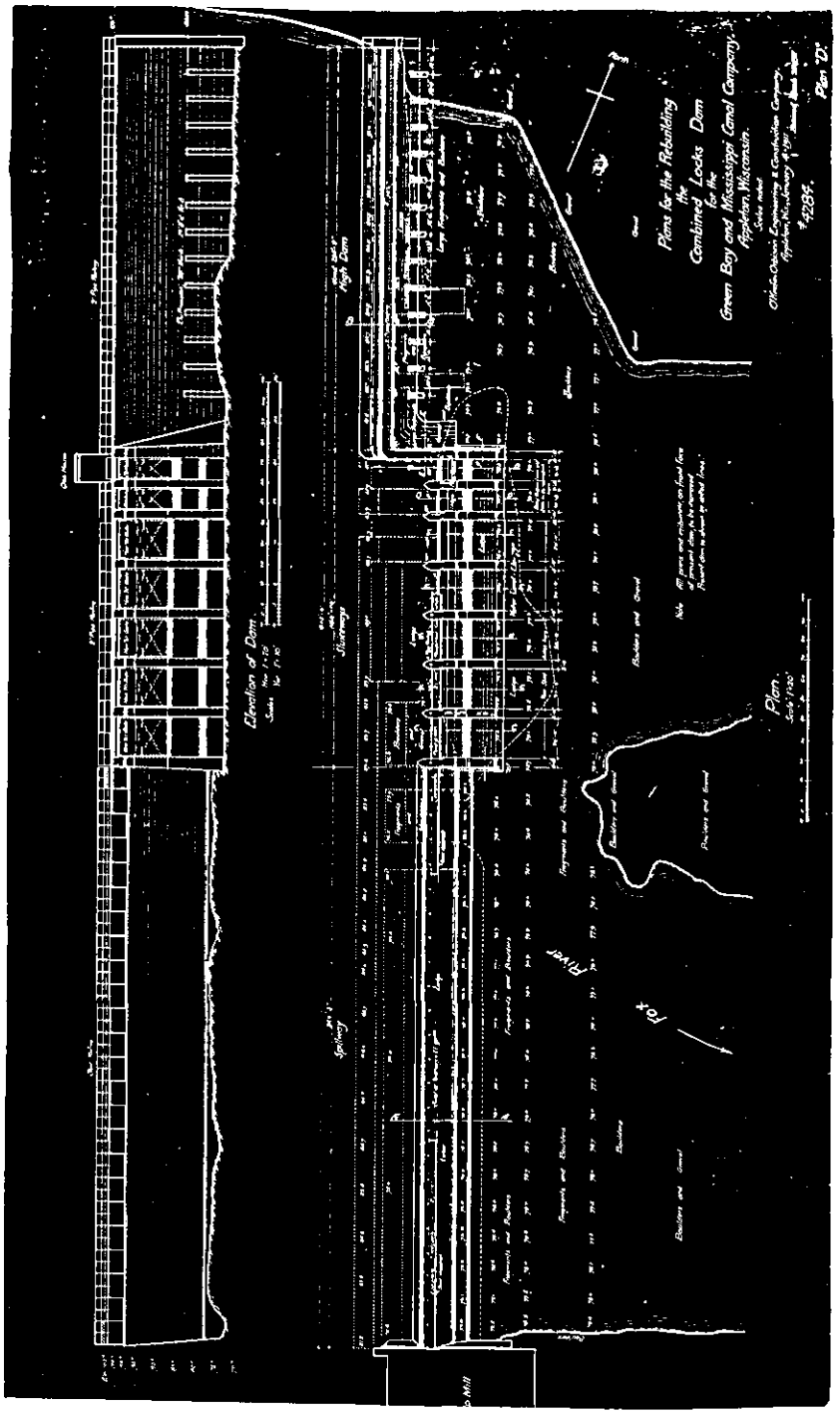

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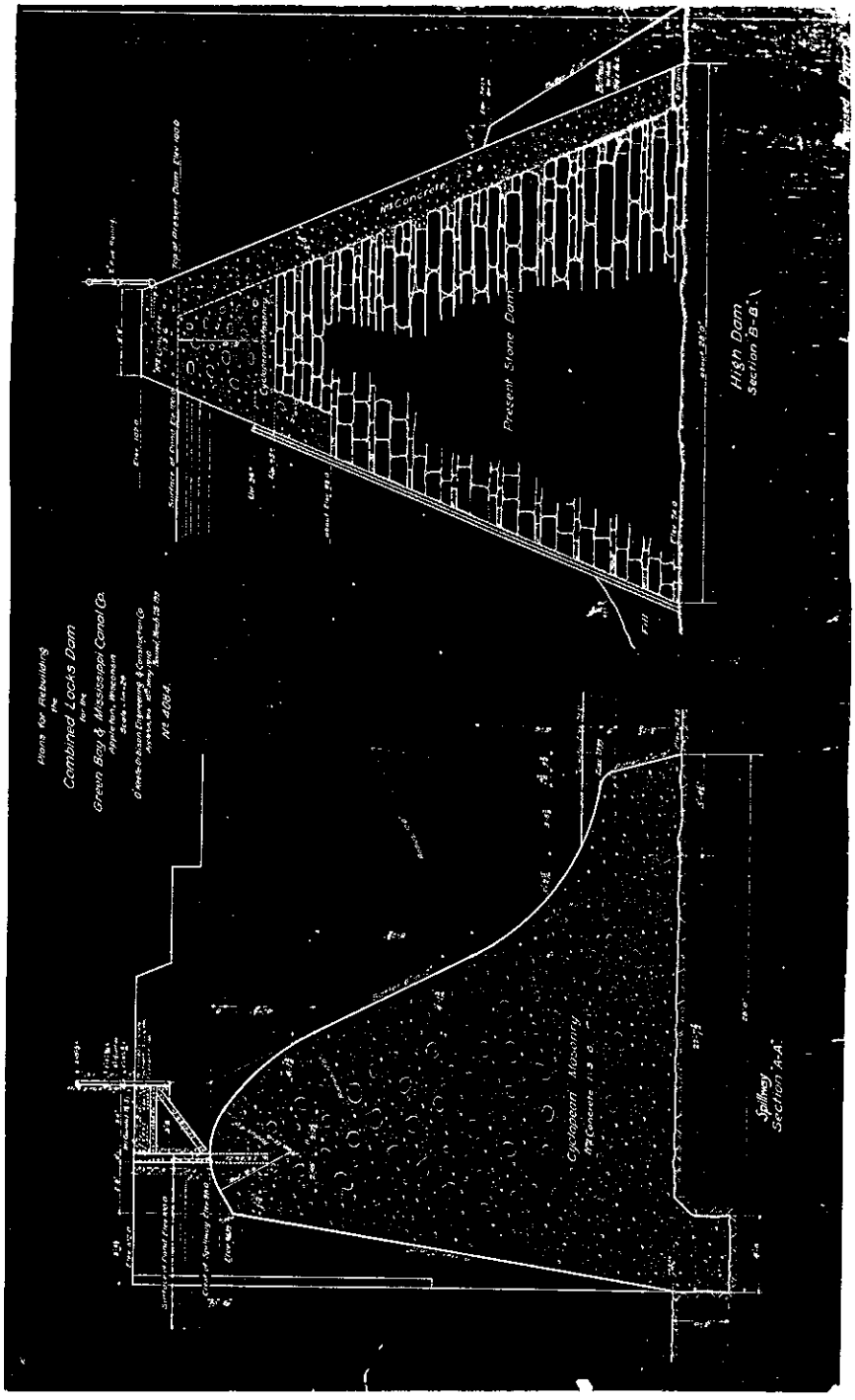

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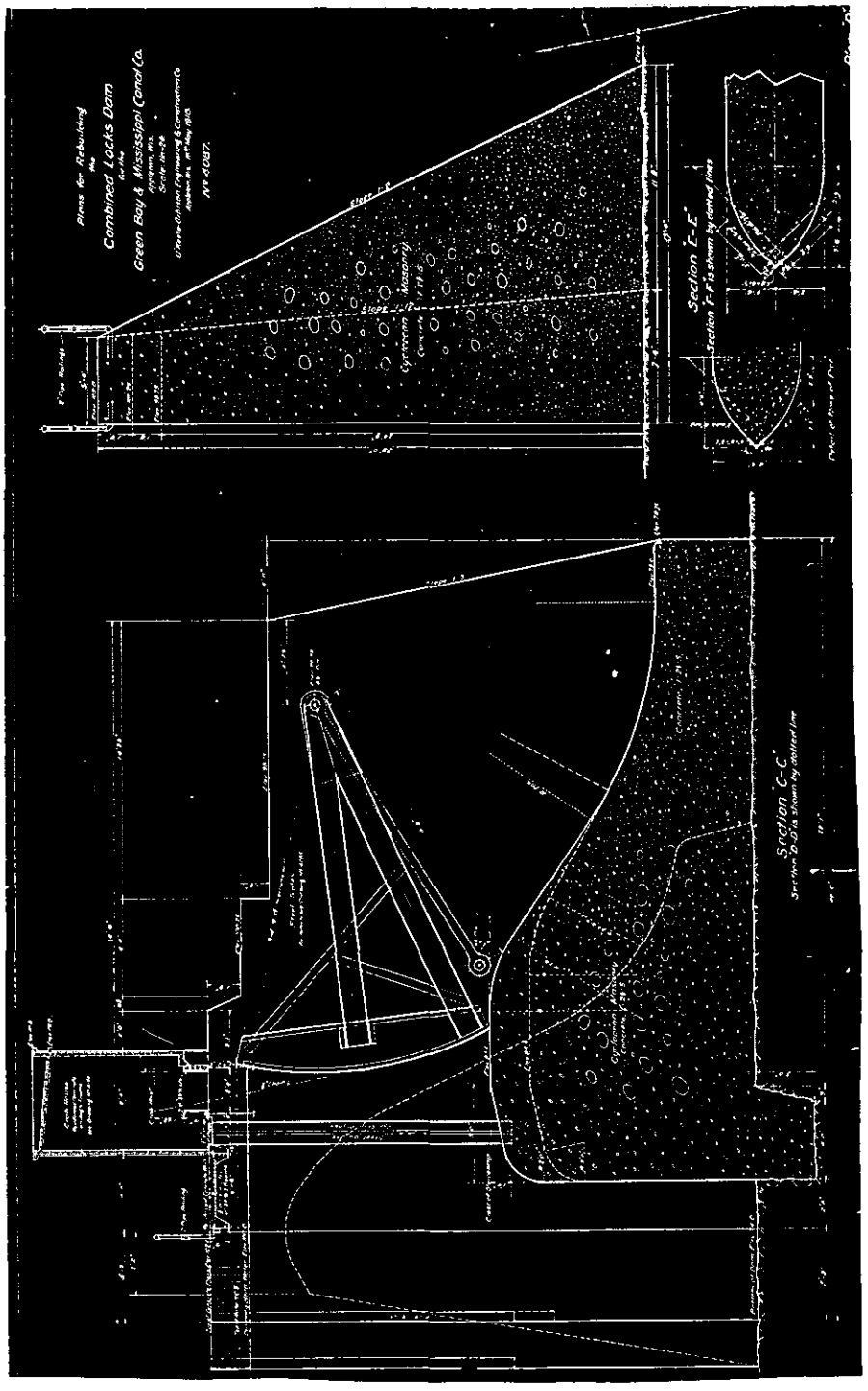

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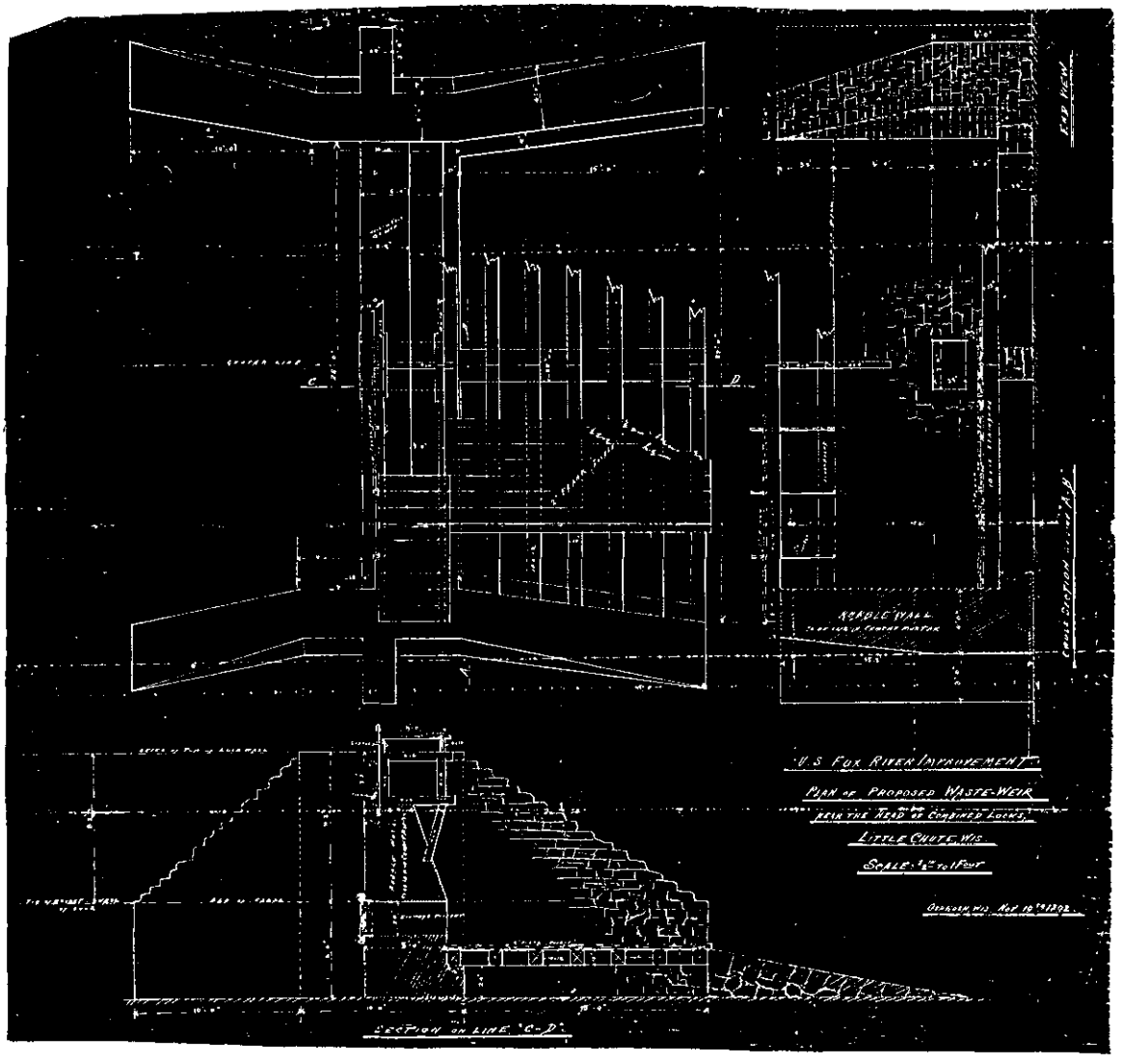

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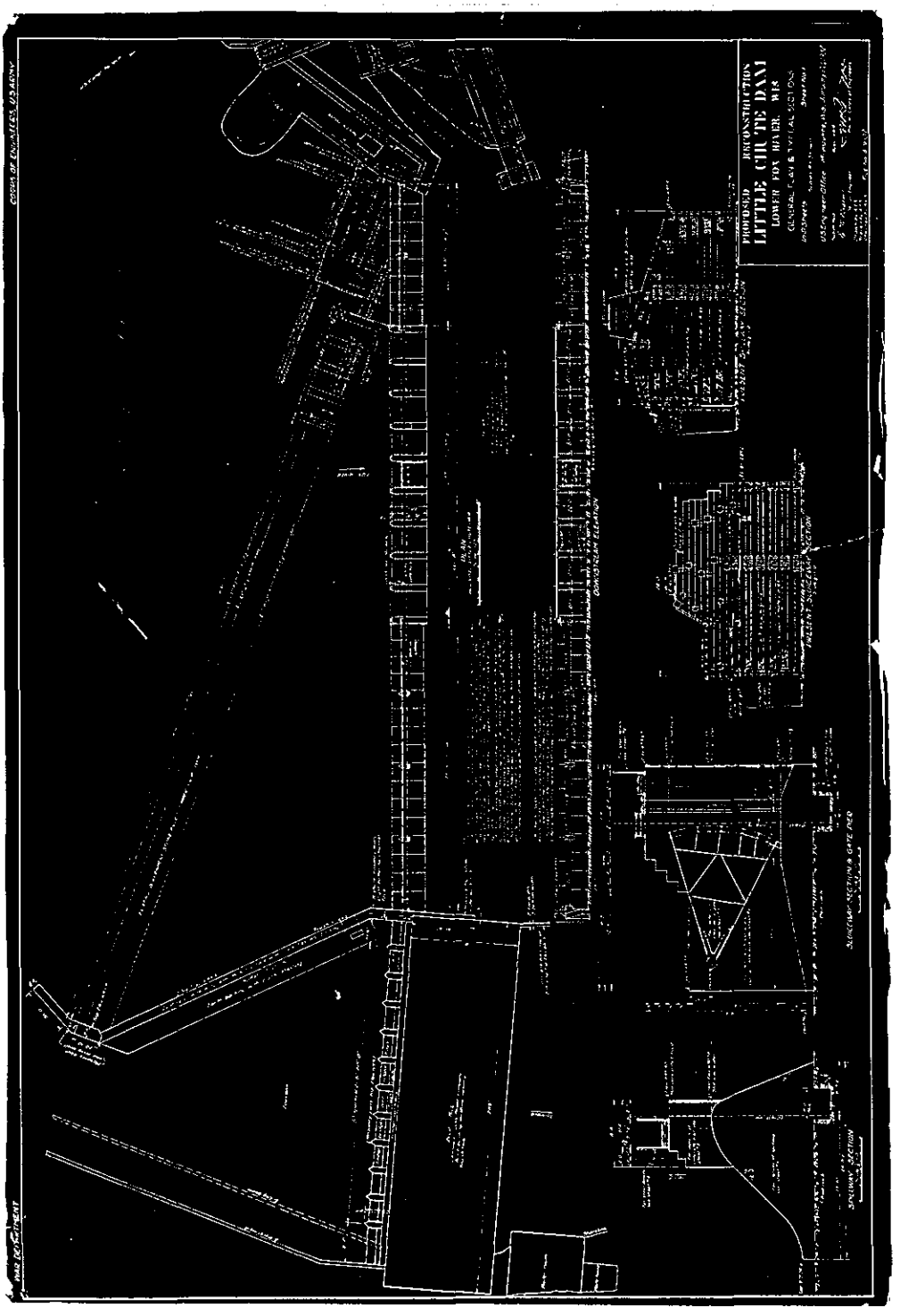

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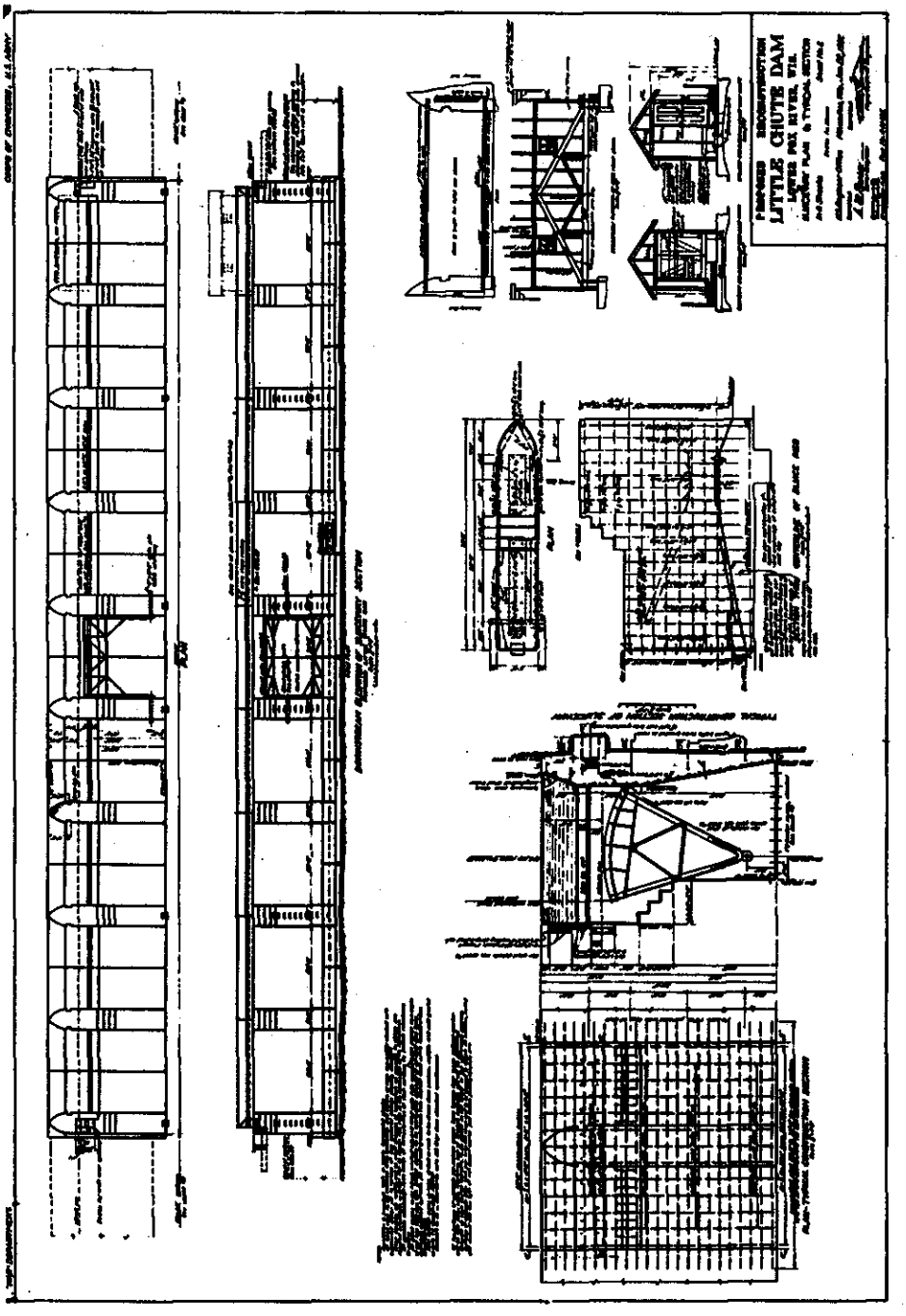

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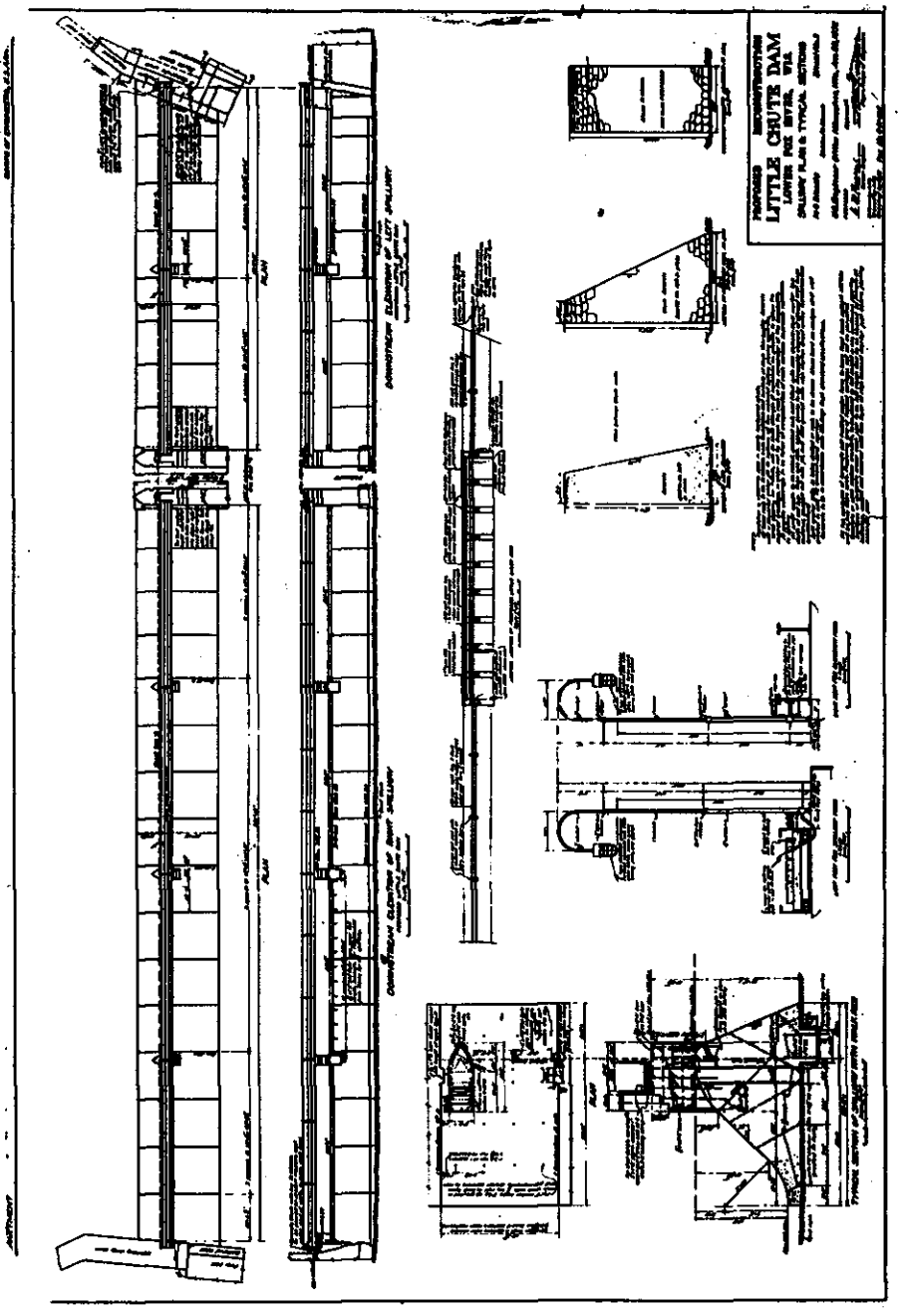

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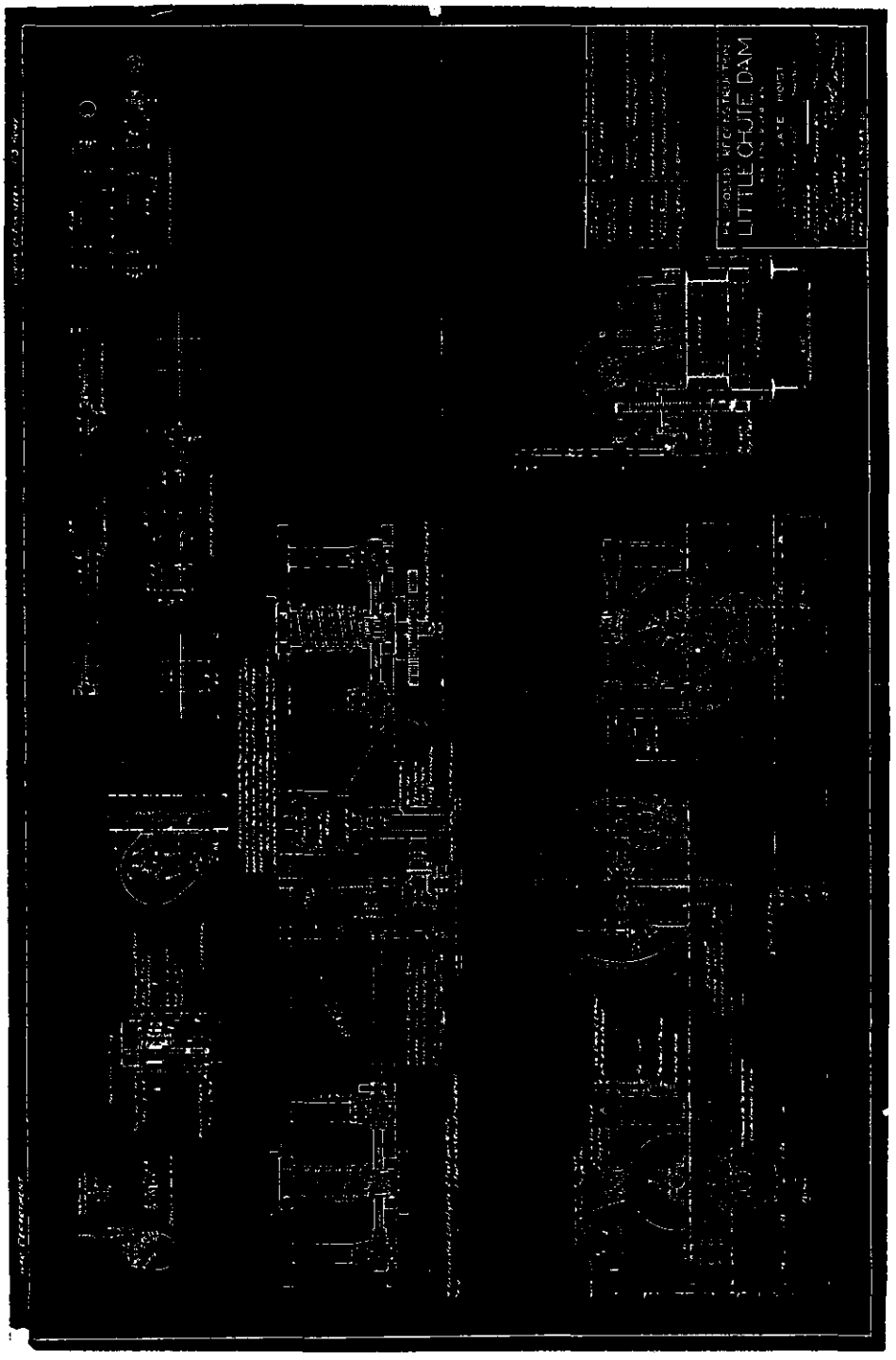

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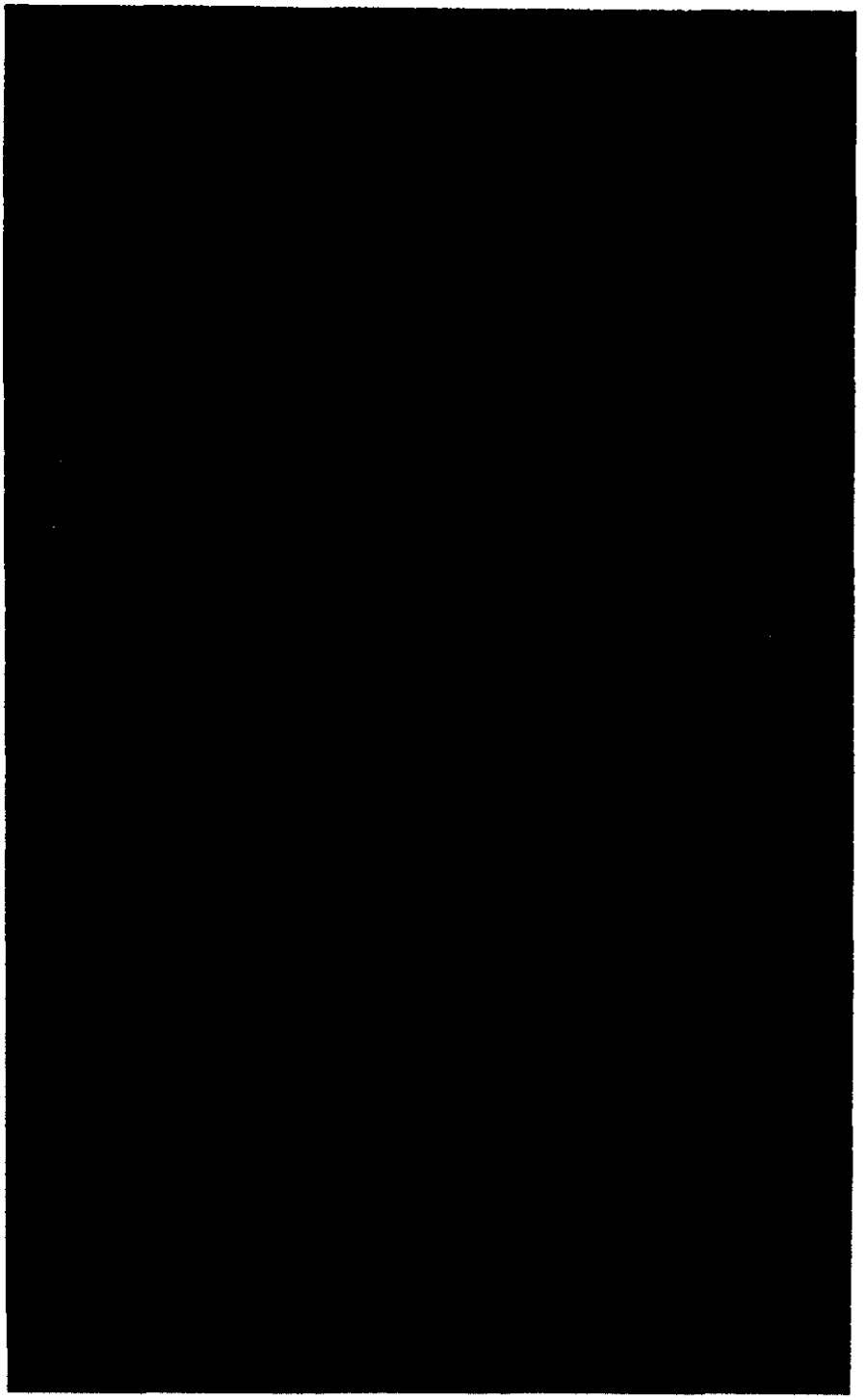

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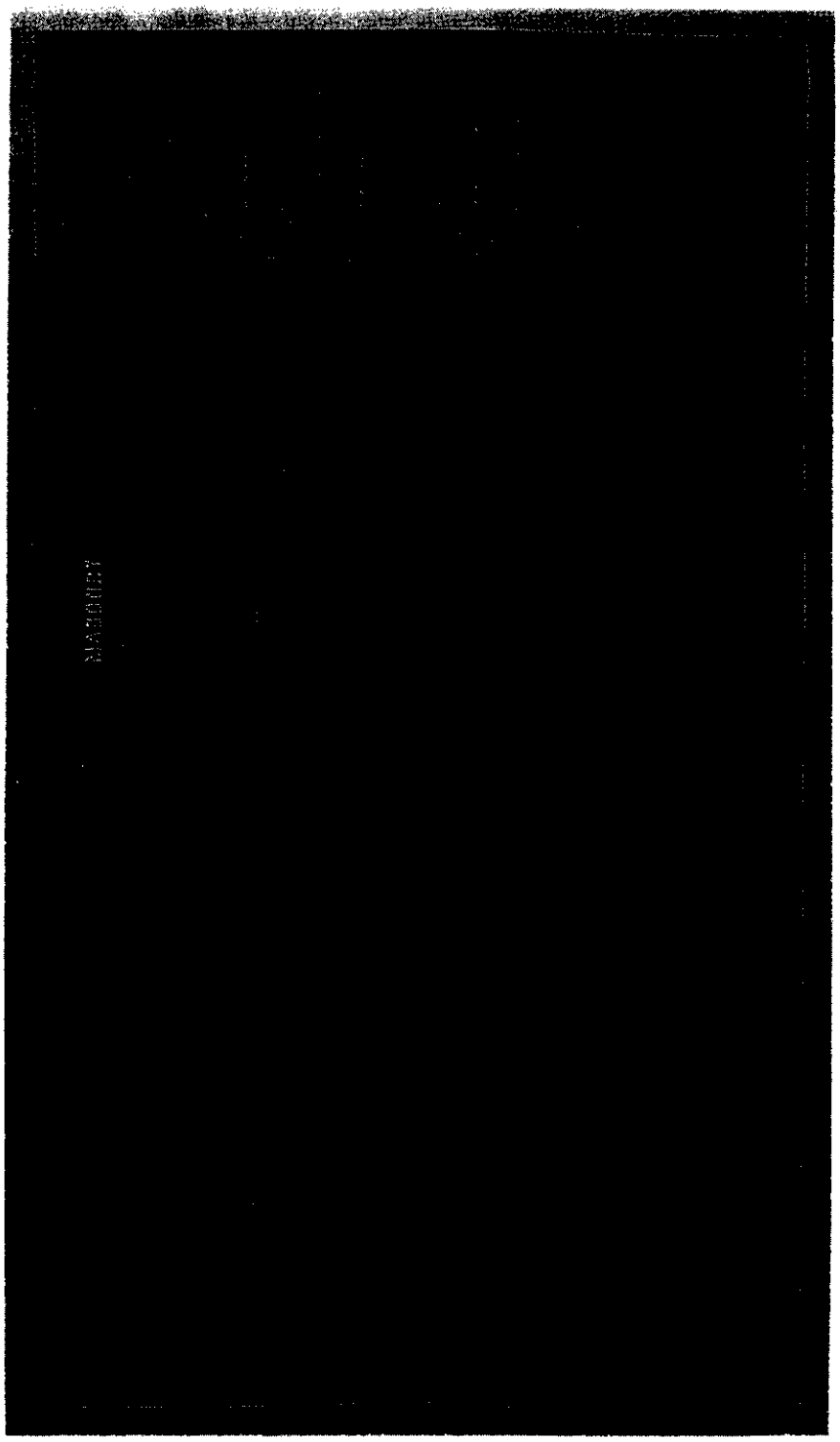

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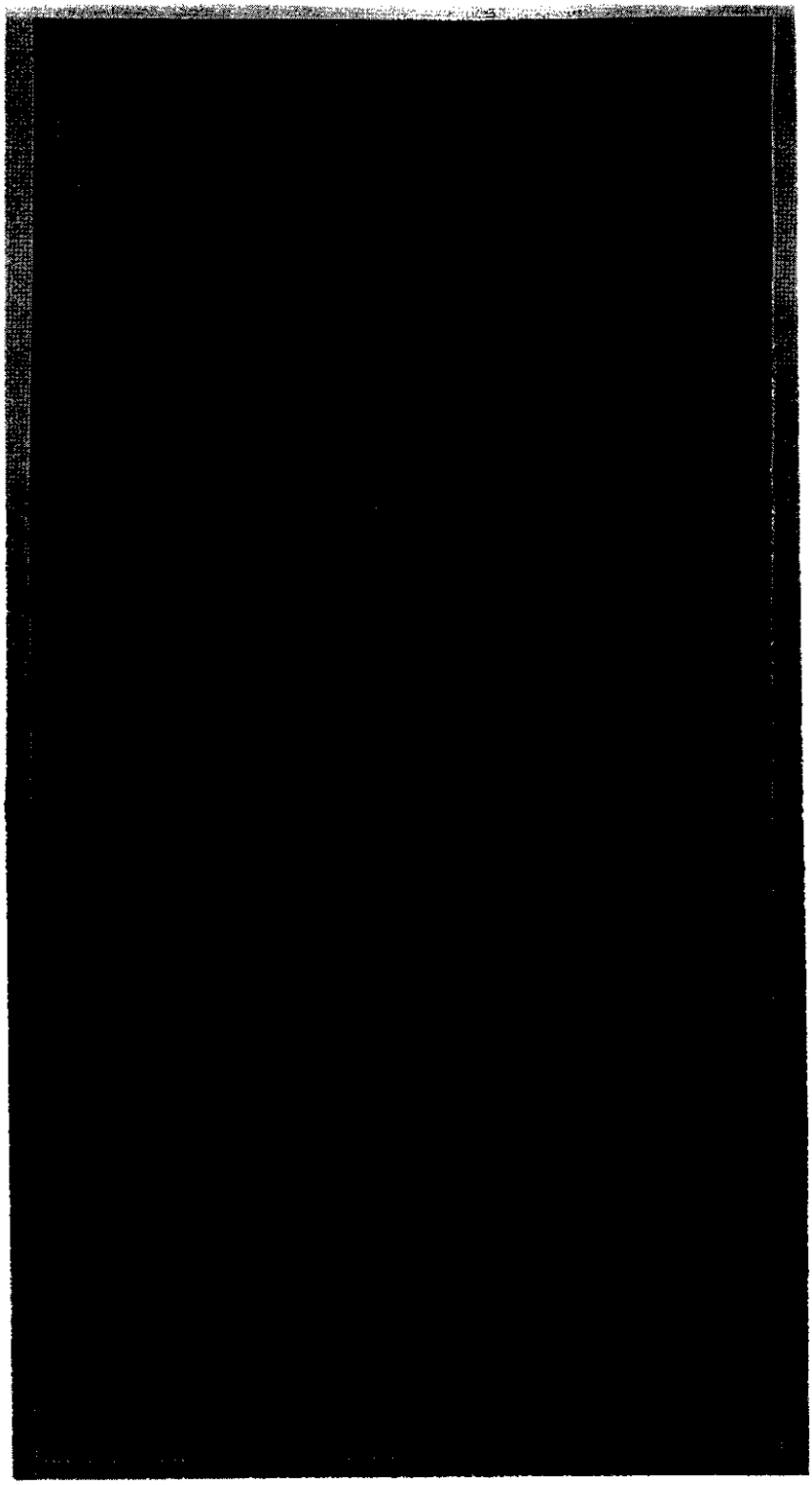

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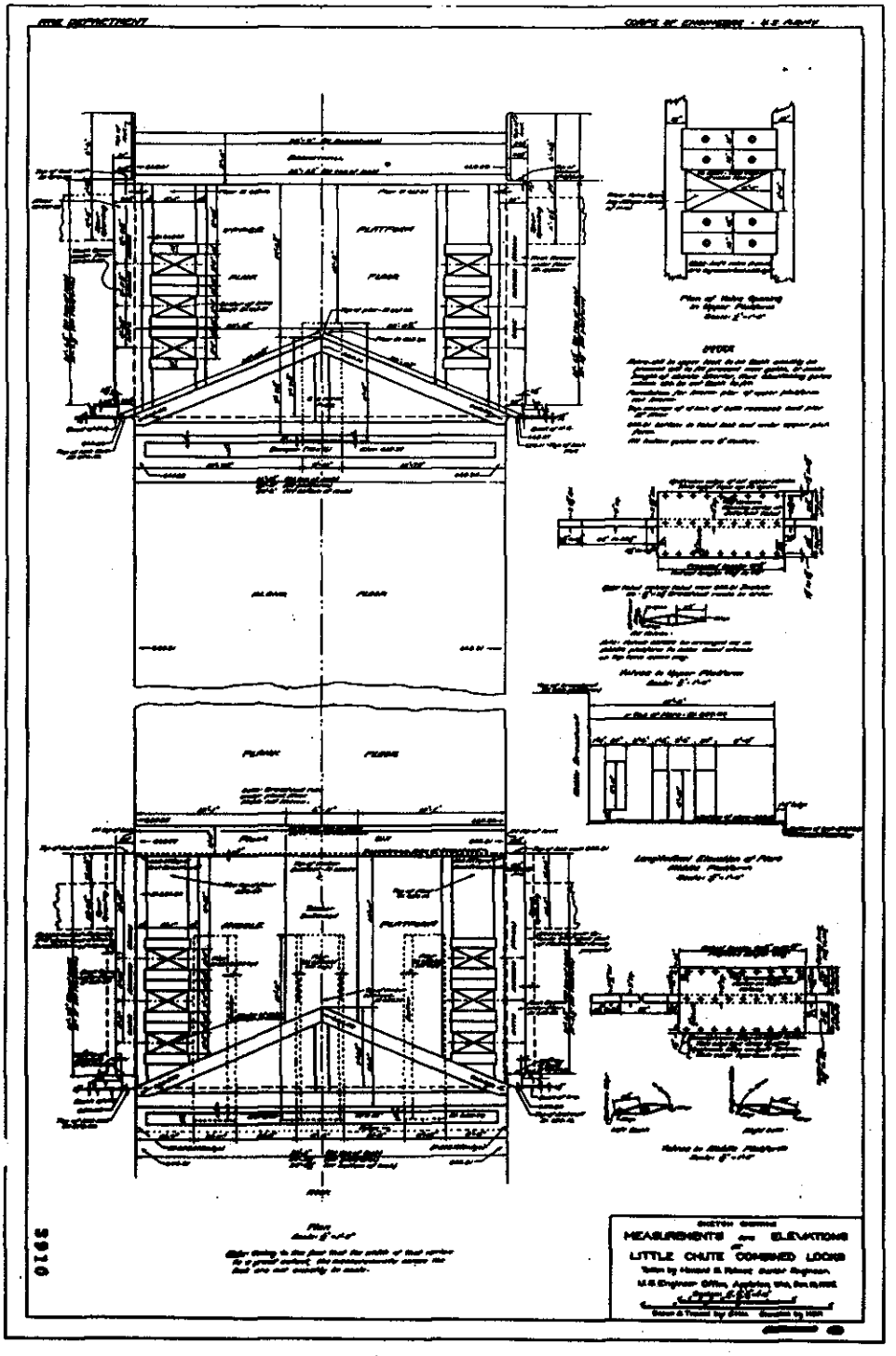

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